1859 FIFTY-EIGHTH YEAR 1917

JAN 29 1917
UNIV. OF MICH. LIBRARY

AMERICAN GAS ENGINEERING JOURNAL

FORMERLY

AMERICAN GAS LIGHT JOURNAL

VOL. CVI., NO. 5
WHOLE No. 3073

NEW YORK, SATURDAY, JANUARY 27, 1917

Subscription $3 per year
$4 Canada $5 Foreign

Street Scene in New Orleans

New Orleans' corrosive soil holds no terrors for Cast Iron Pipe—

SERVICE MEASURED BY CENTURIES
CAST IRON PIPE
THE FIRST CAST IRON PIPE EVER MADE IN THE WORLD'S HISTORY IS STILL IN SERVICE
MORE THAN 250 YEARS OLD

Pipe laid there in 1836 proved its remarkable durability, notwithstanding the very soft clay, the large amount of peat and vegetable matter in the soil, and the ineffective drainage system.

This good showing was responsible for New Orleans' selection of 570 additional miles of Cast Iron Pipe in 1906—

Another tribute to Cast Iron Pipe—another chapter in the long story of its universal satisfactory service.

The Cast Iron Pipe Publicity Bureau

1 Broadway, New York

INDEX TO CONTENTS, PAGE 108 ADVERTISERS' INDEX, PAGE 18

The Money and Labor Saving Machinery for the Gas Man

We Make 4 Machines Especially Adapted for the Use of Gas Companies

Model 18	cut 9″—12″—15″—18″ wide	and up to 6′ deep
" 24	" 12″—15″—18″—24″ wide	" " " 10′ "
" 36	" 18″—24″—30″—36″ wide	" " " 15′ "
" 48	" 24″—30″—36″—42″—44″—48″ wide	" " " 18′ "

Write for specifications, or tell us about your work and we will make recommendations.

The Parsons Co., 410 4th St., Newton, Ia. Eastern Sales Office: 18 W. 34th St., N. Y.

We recommend our BACKFILLERS for any contract.

Parsons

Here's what the Parsons Backfiller saves you in a day's work: The expense or hire of fifteen teams and drivers, and the wages of about five extra men.

Backfiller

This machine fills, hoists and dumps a big scraper load every 15 seconds. And it has stability — cannot slide or tip over. Write for new Backfiller Catalog.

AMERICAN
GAS ENGINEERING JOURNAL

FORMERLY THE AMERICAN GAS LIGHT JOURNAL

Vol. CVI, No. 5 NEW YORK, JANUARY 27, 1917 Whole No. 3073

Advantages of Gas for Production of Varnish, Make Its Installation Highly Advisable in Many Cases

Comparative Tests Show It More Economical Than Oil At 60 Cents per Thousand Cubic Feet, on Fuel Costs Alone—Gas Furnace Does Not Require Skilled Attention

By HENRY L. READ

Engineering Department, Surface Combustion Company, Long Island Ctiy, N. Y.

At the plant of a large manufacturing company is a department given over to the production of varnish, much of which is used for electric insulation. The process consists essentially in raising a charge of linseed oil to a temperature of 580 deg. Fahr. in between three and four hours, and holding this temperature for around five hours more. In the oil are dissolved the pitch, copals and other ingredients used.

Close regulation of the amount of heat put in is necessary, as an exothermic reaction is started if higher than 585 deg. Fahr. is attained. Consequently, a peculiarly inefficient and wasteful furnace construction was adopted by varnish experts over a hundred years ago, using coal or coke, and, owing to the conservatism of those in charge of the industry, and the fact that secrecy in its conduct has always been considered vital, practically no changes have been instituted in the method of heating since the early days.

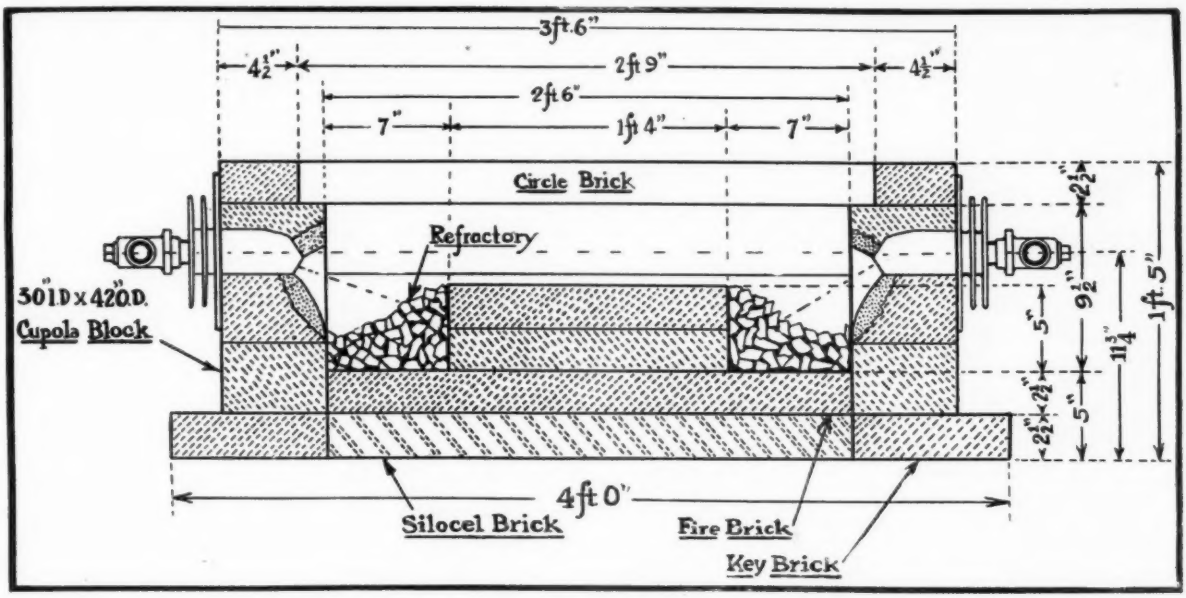


FIG.1. CROSS SECTION VIEW SHOWING IMPACT BURNERS.

Existing Furnaces Holes in Brick Floors of Buildings

The existing furnaces are ordinarily circular holes of suitable diameters in the brick floors of the buildings, with their tops flush with the floors, which are level with the ground. A sufficient excavation, all of which except the part immediately over the fire is covered by a proper grating, is made to allow access for removal of ashes, etc. Air is supplied below the grates by a fan.

Over these crude affairs are run the varnish kettles on wheels, clearing the ground by about 6 in. The flue gases escape through this 6-in. space, rising alongside the pot, and being led off through a chimney higher up mixed with the fumes from the oil.

The kettles are usually of copper, or at least provided with copper bottoms, and are not insulated.

The advantage of the foregoing construction is that at any time the heating may be stopped completely by pulling the pot away from the fire.

As a varnish fire which may be started whenever more than 585 deg. Fahr. is reached is a most troublesome and annoying thing to the workmen, aside from the monetary loss involved, the value of this feature has, at least until recently, more than overcome the cost of the excessive amount of fuel burned.

In the plant under discussion, the heating was done by oil, with the other details unchanged from standard practice. Of course, greater accuracy of control was thereby possible than with a coal or coke fire. But a progressive gas salesman induced the management to install a Surface Combustion Fire under a guarantee to meet certain conditions of operation and fuel consumption. The guarantee was fully met.

Figs. 1 and 2 show two views of the installation. The usual Surface Combustion impact burners and controlling devices were used, supplied with air under 1¼ lb. per sq. in. pressure.

New Kettle Built

No radical variation from the old and well understood principle of heating varnish was permitted by the consumer, but he was willing to do something toward giving the new system a thorough tryout.

A new kettle was built about four feet in diameter and two feet high, clearing the ground by 2½ in. Insulation covered the lower half of the side wall. During operation, the 2½ in. space between the pot and the top of the furnace was closed by bricks except for small openings for the flue gases. These alterations were only possible because of the delicacy of control obtainable.

After the appliance had been in operation long enough for the operator to become thoroughly familiar with it, two comparative tests were run under slightly different conditions, giving the results shown in table.

The gas furnace was handled by the regular varnish man on this work without any particular adjustment or attention other than turning the air valve up or down as more or less heat was required, since the system of control automatically keeps the proportions of gas and air constant and correct after it has been once properly set.

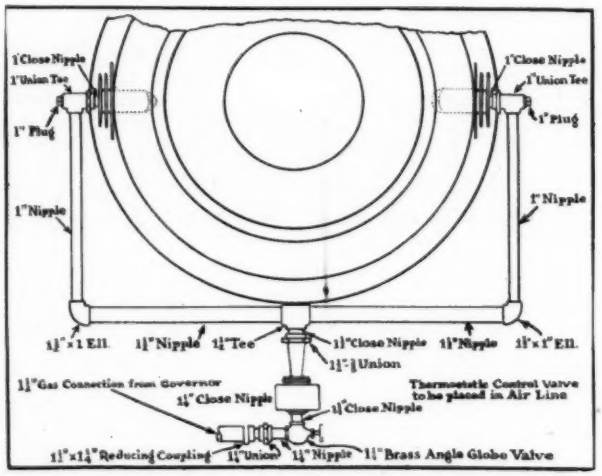


FIG. 2. CONTROLLING DEVICES SUPPLIED AIR AT DETERMINED PRESSURE

The oil furnace, however, had the frequent attention of the consumer's fuel engineer and was run under the most favorable conditions. It is not probable that the given results on oil could have been obtained in actual practice, whereas those on gas were what would be expected in normal working.

Even with expert attention the hourly rate of oil was distinctly different in the two tests, and the difference is brought out in a consideration of the relative costs.

With gas at $0.60 per 1,000 cu. ft. and oil at $0.055 per gal., the cost of the gas in Test 1 is $0.96 and that of the oil $0.66. In Test 2, the gas is $1.08 and the oil $1.045.

These figures include only the actual fuel. To the oil must be added charges for storage, pumping, steam for heating, clerical work, increased cost of repairs to the furnace, and air under a comparatively high pressure, together with greater difficulty in control.

When everything is allowed for, especially the uncertainty of oil furnace operations, it will be seen that the cost of running a gas varnish pot as described is not more than that of running an oil pot, and the advantages of the former make its installation highly advisable in many instances, even replacing coal as has been done in a large city where the gas costs $0.80 per 1,000 cu. ft.

Test No.	Weight Linseed Oil, Lb.	Time of Run.	Cu. Ft. Gas Used.	Gal. Oil Used.	B. t. u. Supplied in Gas.	B. t. u. Supplied in Oil.	Heat Saving by Surface Combustion.	Average Cu. Ft. Gas Per Hour.
1.....	1,100	8 hrs.	1,600	12	960,000	1,683,000	59.4%	200
2.....	1,100	9 hrs.	1,800	19	1,080,000	2,665,000	43%	200

Baltimore's Output Record

New high records of the gas output by the Consolidated Gas, Electric Light & Power Company of Baltimore, were established in December, the output for the seven days ended Dec. 18 having been 117,137,000 cu. ftft. as against 97,772,000 in the corresponding week of 1915, an increase of 19,365,000 cu. ft. This is equal to an average increase per day of 2,766,000 cu. ft. or 20 per cent. The maximum day's output to date was on Dec. 19, the total being 18,119,000 cu. ft. as against 15,486,000 on the corresponding day a year ago, an increase of 2,633,000 cu. ft., or 17 per cent.

Adoption of New Rate Schedule Brings Many Advantages to Martinsburg Gas Company

Based on Sliding Scale Principle—Carries Minimum Charge—Gas Sales Show Consistent Increase

By LEON H. WARE

Superintendent, Martinsburg Gas Company, Martinsburg, W. Va.

A new rate schedule, based on the sliding scale principle and carrying with it a minimum charge of 60 cents per meter per month, became effective at Martinsburg, W. Va., on July 1, 1916. The new schedule is as follows:

		Gross.	Net.
First	1,000 cu. ft. con. per mo.	$1.50	$1.50
Next	1,000 cu. ft. con. per mo.	1.45	1.35
Next	1,000 cu. ft. con. per mo.	1.35	1.25
Next	2,000 cu. ft. con. per mo.	1.30	1.20
Next	5,000 cu. ft. con. per mo.	1.25	1.15
Next	10,000 cu. ft. con. per mo.	1.20	1.10
Next	20,000 cu. ft. con. per mo.	1.15	1.05
Next	30,000 cu. ft. con. per mo.	1.10	1.00
Next	50,000 cu. ft. con. per mo.	1.05	.95
Next	100,000 cu. ft. con. per mo.	.95	.85

DISCOUNT, PROMPT PAYMENT—A discount of 10 cents per 1,000 cu. ft. consumed (excepting on the first 1,000 ft. consumed) will be allowed on all bills rendered at the above gross rates, if paid at the office of the company on or before the 10th of the month following that for which bill is rendered.

MINIMUM CHARGE—A minimum charge of sixty (60) cents per month per meter, will be made on which a discount of 10 per cent will be allowed if bill is paid on or before 10th of month following that for which bill is presented.

This schedule supplanted the former charge for gas, which was $1.50 per 1,000 ft. with no discount, excepting on bills of an amount of $5.00 or more in one month, when 10 per cent. discount was allowed for prompt payment. This charge applied to all classes of consumers, excepting those using gas for industrial purposes, in which case the consumer would be charged $1.25 net per 1,000 ft., providing 25,000 ft. or more were used in one month. Hotels for fuel purposes only, were charged $1.00 net per 1,000 ft. providing 50,000 ft. or more were used in one month. There was no minimum charge under the old rate.

REASONS FOR INTRODUCTION

Martinsburg has a population of 12,500, most of which is covered by the company's lines, both high and low pressure. In order to arrive at some tangible basis from which to make calculations for a new rate schedule, we first made complete monthly analyses of our consumers' accounts, which numbered about 1,650, these analyses covering a period of nearly two years. The consumers were classified into nine classes, according to the quantity of gas consumed each month.

The following analysis for the month of March, 1916, will give an idea as to how the accounts ran:

CLASS.	AMT. CONS.	CONSUMERS.
No. 0	Nothing	342
No. 1	0- 500	459
No. 2	500- 1,000	358
No. 3	1,000- 2,000	263
No. 4	2,000- 3,000	75
No. 5	3,000- 5,000	41
No. 6	5,000-10,000	12
No. 7	10,000-20,000	9
No. 8	Over 20,000	3

The above analysis is typical of practically all of the winter months during the past few years. One reason that no doubt contributes largely to so many people not using gas in the winter months, is the fact that comparatively few houses are equipped with a furnace heating system, thereby being practically compelled to have some kind of a coal range in the kitchen.

Summing up we learned, much to our surprise, that during the six colder months of each year, there was an average of over 300 consumers using no gas each month and about 500 consumers using considerably less than 500 ft. each per month. This showed that approximately 50 per cent. of our consumers were practically costing us money to serve while the other 50 per cent. were carrying all of the expense.

During a period of several years, we had given our consumers every inducement to use gas for all purposes in reasonable quantities, by offering free installations of piping for stoves and for house lighting, etc., but apparently we were unable to bring the larger number up to what might be termed a profitable basis. For the above reasons, as well as to meet a more or less popular demand for lower rates for gas, we decided that the proper time was at hand for us to revise our rate schedule.

In figuring out the minimum charge, we took into account our office expense, complaints, repairs to mains and services, meters, etc., taxes, and interest on physical valuation, which showed a cost of approximately 60 cents per meter per month.

Our principal object, in placing in effect the new sliding scale of rates, was to reduce the price of the second, third, fourth, fifth and so on thousand feet of gas, effecting a reduction in price to the profitable class of consumers, at the same time placing a minimum charge of 60 cents in effect, so that when the month's totals or sales were figured, we would not have materially reduced our average price received per 1,000 ft. for gas.

For comparison, the average price received for all gas sold during the latter six months of 1915 was $1.425; while the average price received during the latter six months of 1916 was $1.421.

INCREASES SHOWN UNDER NEW SCHEDULE

Under the new rate schedule, we have shown increases in actual sales of gas of 2 per cent. in July, 6 per cent. in August, 11 per cent. in September, 3.6 per cent. in October, 6.2 per cent. in November and 12.5 per cent. in December, 1916, over the same corresponding months of 1915; while the first six months of 1916 show no increase over the same six months of 1915, the sales being about the same amount.

While slightly improved local business conditions are partly responsible for the above increases, we are confident by actual investigation of individual consumers' accounts, that our new rate schedule has brought about the greater part of the increase.

On July 1, 1916, approximately 80 per cent. of the meters in service were of the pre-payment type, the remaining 20 per cent. being regular meters. Since July 1, 1916, we have removed a little over 250 meters on account of refusal to pay the minimum charge of 60 cents. At the same time, we have collected an average

of over 100 minimum charge accounts each month, most of these accounts being on pre-payment meters.

In collecting a minimum charge account on a pre-payment meter, credit is allowed for any amount of gas consumed at rate of 15 cents per 100 ft.

We anticipate that at least 80 per cent. of the 250 meters removed for the winter months will be set again next spring, when each meter re-set under such conditions will have a charge of $1 attached, which charge is standard under the ruling of the public service commission.

All pre-payment meters are set at the rate of $1.50 per 1,000 ft. and a rebate list is made up each month, the rebates being payable to the consumer at periods of three months.

Following are some of the advantages we feel we have derived by the application of the new sliding scale of rates: We find that a large number of our customers are well pleased with the reduction on all gas in excess of 1,000 ft. used in one month; we now show by actual analysis, an average of not over 40 consumers using no gas in any one month; of all the meters removed, we have evidently not lost any gas sales; a large number of our small consumers are using considerably in excess of the minimum charge amount of 400 ft. in one month; practically all of the consumers now using gas should soon be in the profitable class; we have 250 meters less to read each month during the winter time, to answer complaints on, etc., and, further, it has placed our charges for gas service on a more equitable and a business-like basis. We also have some inducement to offer present consumers to use more gas.

It has increased our sales of mantles, lighting equipment and other small appliances and has placed the company in much better position to secure industrial fuel business, as well as serving to increase consumption by our present larger consumers.

It is further serving as a means of education to our present consumers, to make them all-year-round consumers, by reason of their being required to use at least 400 ft. of gas during each month of the year, or pay the minimum charge of 60 cents.

We feel that our new rate schedule has thus far worked out very satisfactorily and if it continues along the same line, we hope in the near future to be able to make a further reduction in price, starting with the initial thousand feet.

The writer firmly believes that the sliding scale basis is the best one by far, for charging for gas service in the smaller towns, and that this kind of rate will prove to be most productive in gas sales and in new business.

Tendency in Scientific Management to Ignore Human Element

In these days of so-called (and often mis-called) scientific management, there is a growing tendency by some, but not by all, to ignore the human element in industry—to create human industrial machines for the production of goods at maximum speed and minimum cost without giving much thought to the human side of the problem, declared James Logan, formerly mayor of Worcester, Mass., in a recent address before the Worcester Branch Association of the Worcester Polytechnic Institute Alumni. There is a mechanical spirit abroad in the world which is producing mechanical qualities of mind which has a tendency to wither up the ordinary human feelings.

Efficiency is greatly to be desired, but not at the price of spiritual barrenness and poverty of soul. In our search for efficiency or for things scientific we must not throw away the finer things of the spirit and become slaves of materialism and worship efficiency, bigness or so-called success.

Gas-Fired Furnace Supersedes Coke for Frying Potato Chips

Rate of Making Chips Increased 60 per cent and Net Cost per Pound Reduced—Second Furnace Contemplated

A gas-fired furnace for manufacturing potato chips has been designed and installed by the Rochester Railway & Light Company, which, according to Samuel S. Amdursky, has increased the rate of manufacture 60 per cent over the coke-fired equipment formerly in use and has reduced the net cost per pound. The product of the coke furnace besides being somewhat non-uniform due to poor heat regulation, was more or less greasy at times. The handling of the coke and the ashes also had its accompanying disadvantages.

GAS-FIRED FURNACE

Mr. Amdursky describes the process of making potato chips as follows:

The potatoes are dumped into a washing and peeling machine which removes most of the dirt and the skins. The potatoes are then inspected and all bad spots removed by hand before they are placed in a slicing machine which slices the potatoes into chips of about 1/32 of in. in thickness.

The freshly cut chips are transferred to a tub of clean water to be washed, from which they are taken and immersed in a second tub of water to be cleansed still further. From the second tub the chips are placed in a draining vessel, and then into a basket to be slowly immersed in a frying bath of lard at about 350 deg. Fahr.

COKE-FIRED FURNACE

The chips are fried until they are of a light brown color and in a crisp state. They are then removed to a bench to be salted, after which they are ready to be packed for the trade.

The accompanying illustrations show the coke-fired caldron furnace and also the gas-fired furnace which replaced it, resulting in a clean and uniform product.

Camden Benzol Plant Will Take Care of All Gas Drip from Southern New Jersey

At Present Recovers Benzols in Fuel Gas Used for Heating Coke Ovens of Camden Coke Company—Surplus Gas Sold for Domestic Purposes

The benzol plant at Camden, N. J., operated in connection with the by-product coke plant of the Camden Coke Company, is an interesting development in the by-product coking industry in the United States.

The plant recovers benzols in the fuel gas used for heating the coke ovens, and not from surplus gas from the by-product coke plant which is delivered in New Jersey for domestic uses, as this gas has a candle power as well as a heat-unit standard. The benzols are recovered in the form of light oil, redistilled and purified, and finally delivered in the form of pure benzol, pure toluol and pure solvent naphtha.

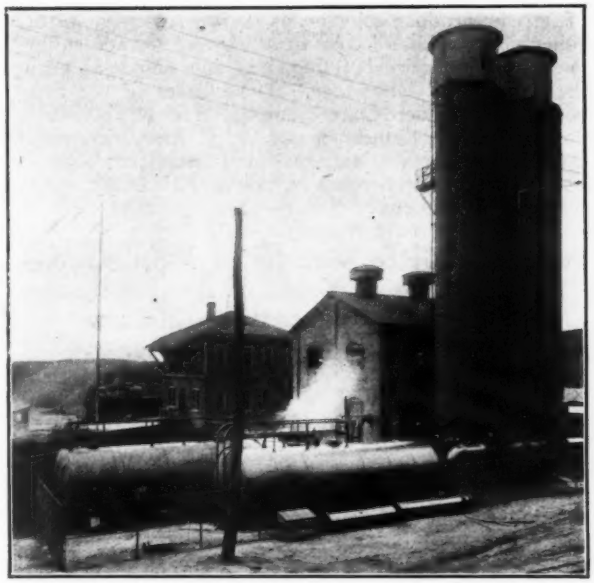
This plant was built by H. Koppers Company of Pittsburgh, Pa., and is similar to other benzol plants built by the same company. It is a thoroughly complete plant and one of its principal features is the low operating cost both in steam consumption and labor.

This installation is operated by the Seaboard By-Product Coke Company of New Jersey in connection with the Camden Coke Company. The operation is under the direct supervision of G. H. Wardlow, operating superintendent.

Enlargements of the plant are now being made by H. Koppers Company to take care of all the gas drip from the southern section of New Jersey. This gas drip will be distilled and worked up into benzol products.

The coke plant of the Camden company has been in operation for thirteen years. During the first few years of its operation there was constructed a benzol plant of a different type and make, which was discontinued and dismantled because it could not be profitably operated. In the interval the benzols contained in the fuel gas for heating the coke ovens served no other purpose than to supply some heat to the coke ovens.

H. Koppers Company is also building at Jersey City, N. J., a by-product coke plant for the Seaboard By-Product Coke Company. The installation will consist



LIGHT OIL AND PURE PRODUCT STILL ROOM AND STORAGE TANKS

BENZOL WASHERS AND WASH OIL ROOM—OVENS SHOWN IN LEFT BACKGROUND

of 110 by-product coke ovens, benzol recovery plant, boiler plant, coal and coke handling and storage equipment, men's service building, machine shop, gas purifiers, office and laboratory. The officers of the Seaboard By-Product Coke Company are H. B. Rust, president; C. J. Ramsburg and W. F. Rust, vice-presidents; S. T. Brown, secretary and treasurer; Donald MacArthur, general manager, and J. T. Tierney, operating superintendent.

Units of Service May Be of More Consequence than Years of Service in Estimating Service Life

The Special Committee to Formulate Principles and Methods for the Valuation of Railroad Property and Other Public Utilities of the American Society of Civil Engineers in its report, published on pages 1907-1938 of the December *Proceedings* of the society, and presented at its annual meeting, held in New York City, Jan. 17, enumerates the following causes of Decretion:

Decretion may be due to use. A machine may have been purchased new, may have been in use a year, may show no signs of wear, and yet experience tells that the machine when new was probably good for only ten years. One of these years has elapsed; the machine is as valuable in its present output of service as ever it was, but, a year of its life has gone into service, and hence, approximately one-tenth of the life of the machine must be estimated as gone, and therefore decretion exists to that extent.

Examination of the particular machine may lead the examiner to estimate that it has still eleven years of service before it, in which case its total life will be estimated at twelve years, and only one-twelfth of its service life will be gone. Examination always should be made, and consideration should be given to the character of past and probable future service, and the method and character of maintenance, because, on all these will depend the estimate of total service life.

Units of service may be of more consequence than years of service in estimating service life.

Decretion may be due to age alone, as some properties grow old regardless of the use to which they are put. Sometimes this aging depends on the care given the properties. Wood decays, iron oxidizes, brick disintegrates, even stone is destroyed by the elements, some kinds more rapidly than others.

The particular use to which these substances are put, whether in sheltered or exposed situations, may determine the rate of decretion, which for some uses may be practically or actually nil, within the range of human estimates. The effect of weathering often may be overcome by periodic repairs, and a given structure may remain in use for many years, and even perpetually, the structure of a given day having in it no item that was in it when it was first built. Such structures will always show some physical deterioration—the immediate or approaching need of some replacements or repairs.

Decretion may be due to immediate or approaching inadequacy. A given machine may be doing a work of constantly increasing magnitude which now or later will require a larger machine before the present one is worn out. The present machine may be good for a considerable service within its capacity. It may have, therefore, a large salvage value, but, for the purpose for which it is being used, it is approaching the end of its service life.

Decretion may be due to obsolescence. A machine may belong to a class that is more or less rapidly changing patterns and forms, due to an advancing art or science. Long before it is worn out, new forms may have been devised which are so much more efficient that it may no longer pay to keep the old machine in service. Or advancing civilization, growth of population, and changing character of social life may call for a different service from that rendered with satisfaction to the people served under the old conditions. This sort of decretion is not due to inadequacy, but to obsolescence.

The several causes mentioned may exist singly or together in a given plant, or plant unit.

Decretion of a plant unit may also be caused by accident.

Decretion is likely to exist in almost every physical item of a going property except land. Even the Pyramids are slowly passing away, and, between items of very long life and those, like working tools, of very short life, there are all degrees of length of service life.

Some properties, like water-works or gas properties, are essentially all new when they begin to operate, because, though some pipes may have been in the ground for some time, their total service life is so long that this preliminary exposure to decay may be neglected.

Shortly after a water or gas property begins to operate, its machinery and structures have begun to deteriorate, and could not be inventoried as new, even for the purpose for which they are used, although they may be giving just as efficient service as new machinery and structures could give.

Due to these facts, no going property could ever be inventoried as new if taken item by item or unit by unit, because some of the service life of practically every item or unit will have passed. As a result of this fact it can be shown that when the properly weighted average of all the decretion of the various units of a well-maintained railroad, for instance, is found, the railroad property as a whole cannot show more than from 80 to 90 per cent. of new condition, or there is estimated, say, 15 per cent. loss of value due to decretion of various units.

Although, in a well-maintained property, decretion is always present in some degree, yet in some cases this decretion, converted into loss of value, should not be considered to be a deductible quantity in finding the value of the property—that is, it should not be considered as depreciation of valuation, or fair depreciation. Unfortunately, this has not been entirely understood.

Whether or not, and to what extent, if any, the loss of value due to existing decretion shall be deducted from original cost to date or cost of reproduction new, when finding fair value for any purpose, is the great troublesome problem of depreciation in valuation.

20,000 Tried Out to Replace 600 Stokers in Paris Gas Works

The experience of the Paris (France) Gas Company should prove illuminating to those who believe stoking a task to which most any kind of intelligence should be capable of grasping. Twenty thousand men were tried out in a vain effort to secure 600 to replace those called to the colors. As a last resort the Government was appealed to to release the apparently indispensable originals.

Artificial Drying an Almost Limitless Field for Use of Gas

Gilbert C. Shadwell Discusses Problems Encountered and Criticises Methods in Use—Thousands of Dry Rooms in Country Exceedingly Inefficient

Until recently little was known of the subject of drying. There existed (and there still exists in many quarters) confused ideas of this important work which are due, probably, to an imperfect appreciation of ordinary common phenomena which are taking place daily in our midst, asserted Gilbert C. Shadwell, of the Improved Appliance Company of Brooklyn, N. Y., in his paper on "Artificial Drying with Special Reference to the Use of Gas"—from which the following has been abstracted—presented at the annual meeting of the American Society of Heating and Ventilating Engineers, held in New York City, January 16-18, 1917.

With some the idea of drying is associated with heat; this probably is due to the effect of heat in removing moisture from various substances. With others the thought is prevalent that wind effects drying; this probably is born of the effect that the wind has in drying sidewalks, roads, etc., after a shower.

A little thought will show that drying is neither accomplished directly by heat nor by air alone, but that air is a common and convenient medium, which, if properly applied, can absorb water or moisture. In order, therefore, that air may be used effectively and economically for the purpose, it is essential that its properties be studied carefully.

Air is capable of "dissolving" water in practically the same way that water is capable of dissolving any such substance as sugar or salt, and in view of the fact that this has a most important bearing on the subject, the analogy will be carried further. Water at any temperature will take up only a certain amount of sugar or other solid solution. Beyond a certain point (termed the saturation point) no more sugar can be dissolved by the water if the temperature remain the same. In order to absorb more sugar or salt in the same volume of water, the temperature of the water must be raised. Moreover, the process of absorption of the sugar or salt will be materially accelerated if the water be put in motion.

Again, it is well known that if sugar be added to a glass of water, the water will absorb most of the sugar at the nearest point of contact, which will, of course, be at the bottom of the glass. If the liquids be allowed to remain unagitated it may take days or weeks for the point of saturation to be reached. So in order that complete saturation or absorption may come about at any one temperature, every molecule of the water must be brought into contact with every molecule of the solid and this is accomplished far more rapidly by stirring the liquid. We may drop in several lumps of sugar in our tea or coffee and yet even at the end of five or ten minutes, the tea or coffee at the top of the cup will not be appreciably sweet, whereas the liquid at the bottom will contain a very high percentage of sugar in solution. It is for this reason that we stir the coffee in order to obtain uniformity of sweetness, or in other words, uniformity of sugar in solution.

Thousands of Dry Rooms Throughout the Country Exceedingly Inefficient

Too much emphasis cannot be laid on this simple fact because the principle of drying where air is the medium, is almost exactly the same as the absorption of a solid, such as sugar or salt, by water. There are thousands of dry rooms throughout the country which have in them gas burners, steam coils, or other sources of heat, and which have no air outlet. They are, in effect, merely sweat rooms—they are exceedingly inefficient. They only accomplish results partially and even so, take a far longer time to do this partial work than is necessary. It is a great mistake that such installations are still made.

In some cases these sweat rooms have effected a fraction of the solution of the problem by the use of fans on the ceiling or elsewhere so as to keep the air in motion and bring about a condition somewhat analogous to the stirring of the cup of coffee with sugar in it. But it is at once apparent that these fans merely churn the air, and as all the moisture is kept in the room, that this air without being changed, cannot be of any use for drying when once it has reached the point of saturation.

It is true that there are certain operations which demand a circulation and recirculation of the same volume of air several times through a dry room before it is finally discharged into the outside atmosphere, but the large majority of drying problems are served best by blowing properly heated air into the dry room, then bringing it into intimate contact with the products to be dried, and finally allowing it to be discharged from the room.

Air must be Kept in Motion and Relative Humidity Low

Two ideas must be kept absolutely separate and distinct: First, the air must be kept in motion, and second, its temperature must be such that its relative humidity is low.

It is possible and perfectly feasible, and is moreover common practice, to accomplish drying at as low a temperature as 70 deg Fahr. This is resorted to extensively, in the drying of products which will not stand a higher temperature, such as the drying of motion picture films, etc. In such cases the air is first of all "squeezed" dry of its moisture by means of refrigerating it and afterwards this dry air has its temperature raised to the required degree by a means hereafter described.

All have noticed the ice which accumulates on the outside of the ammonia pipes in a refrigerating plant and are no doubt aware that this ice is formed from the water or moisture which is condensed from the air in the room, because its temperature has been reduced so much that it cannot retain all the moisture which it carried at the higher temperature; so dew forms on the pipes and is frozen. If air which was saturated at 32 deg. Fahr., has its temperature raised to 70 deg., it will be very dry, having a relative humidity of only about 18 per cent.

As a drying medium air costs nothing; 70 cu. ft. of manufactured city gas will raise the temperature of 20,000 cu. ft. of air from 70 deg. to 170 deg. Fahr., or 10,000 cu. ft. of air from 70 deg. to 270 deg. Fahr., with an air heater to be described later. Twenty

thousand cubic feet of air at 170 deg. Fahr., if saturated, will carry away more than 25 lb. of water; 10,000 cu. ft. of air at 270 deg. Fahr., would carry away an infinite amount of moisture (because this temperature is above the boiling point of water) if the air contained sufficient heat to evaporate the water.

If air with 100 per cent. humidity and at 70 deg. Fahr., be passed through this air heater so as to increase its temperature to 80 deg. Fahr., its humidity will then be reduced to less than 50 per cent. If its temperature be increased to 170 deg. Fahr., its humidity will be reduced below 0.09 per cent. This air will be very much drier than is ever found in nature and will absorb moisture very rapidly indeed.

Moisture-Carrying Capacity of Air in Proportion to Its Temperature

A concrete example will illustrate this: If saturated air at say, 70 deg. Fahr., has its temperature increased only 10 deg., it can then absorb as much more water as it carried at 70 deg. and still have a humidity of less than 50 per cent.

The hotter the air the more moisture it can carry. Ten thousand cubic feet of air at 270 deg. Fahr., contains sufficient heat to evaporate more than 50 lb. of water, but in so doing it gives up some of its heat, bringing the air again below the boiling point of water. From this it is evident that to carry away this amount of moisture efficiently, about twice this quantity of air should be figured.

At this point it is very important to grasp clearly the difference between the heating of products in an oven, and the drying of such articles as, let us say, clothes, paper, etc., in a dry room.

An oven load of lacquered or japanned goods has but an infinitesimal fraction of soluble vapor to the total air in the oven, so that this quantity of air is well able to take care of the vapor as a rule. The heating of products in an oven such as lacquered or japanned goods is strictly a baking proposition and although they become dry, it is not the same kind of drying as takes place when wet products are dried in a dry room.

Meat, bread, etc., when placed in an oven are not dried in the proper sense of the word, although they may give up some of their moisture, but the physical and chemical compositions of such products are definitely changed and we call this change "baking." It is therefore probably a confusion between the processes of baking and drying which has led many people astray.

The problem of heating this air efficiently in order to increase its moisture-carrying capacity is the one of most interest to all of us, because this problem appears in nearly every drying operation. Experiments have shown that nothing will absorb moisture so quickly as warm, dry air in motion.

In order to use heated air for drying so that results will be entirely satisfactory it must be heated efficiently and this has taken many years of thought and experimentation on the part of engineers. The mere heating of air by the means previously in vogue would have been a great handicap to success owing to their inefficiency, but this has been overcome by the use of a type of air heater or hot air generator which will be described later. This heater in conjunction with the proper size of blower, supplies air abundantly and efficiently. By the proper application of warm, dry air the time of many drying operations may be reduced 80 per cent. or even more. By the application of the air heater, which I am about to describe, to some of the so-called dry rooms now in use highly satisfactory results will supersede discouraging failure.

Direction of Air Contrary to Flow of Heat

The air-heater above mentioned is built like a vertical tube steam-boiler and looks somewhat like one. Into a heavy steel boiler head are fastened steel boiler tubes in the same way as they are fitted into the tube sheet of a steam boiler and the hot flue gases pass through them. The body is well insulated with air-cell asbestos which, in turn, is covered with sheet steel for protection. The air inlet is placed at the top. This enters tangentially so that cold air enters the heater at a tangent and circulates between the hot tubes, passes downward and strikes a baffle which directs it against and over the hot flame plate before reaching the outlet. The direction of the air is, thus, contrary to the flow of heat which, together with the large amount of heating surface, makes for the maximum efficiency. The base, or furnace, is made of sheet steel lined with insulating material. A baffle is placed beneath the burner to direct secondary air and to prevent any overheating of the floor. A hood with flue collar is provided at the top.

Calculation of the size of heater to use on any particular installation is very simple. Experience has shown that it is desirable to change the air in the average dry-room from two to five times per minute and the air should be supplied at the highest temperature which the material to be dried will stand.

When high temperatures are used for drying, that is, temperatures above 250 deg. Fahr., the oven or dry-room must be well insulated to prevent the loss of heat through its walls. Also the distribution of the heated air is important. It is necessary that the heated air from the heater be distributed directly to the product to be dried by means of air ducts or pipes. If the air be merely blown into the dry-room, most of it will, except in rare cases, pass around the sides of the product next to the walls of the room and be wasted. Great care should be used in the arrangement of the product to be dried, to see that the air will circulate through or about every particle of it; the results will repay the effort.

In calculating drying problems, if greater accuracy be required, Table 2 may be employed. Column A of the table shows the air temperature leaving the heater to enter the dry-room; columns B and D give the greatest possible amount of moisture which can be absorbed at each temperature; columns C and F show how much air, when saturated, will take up 1 lb. of water. The method can best be illustrated by an example.

Suppose blankets are to be dried, that when dry, they weigh 100 lb., and when wet, 200 lb.; the amount of water to be evaporated will then be 100 lb. Assume the dry-room to be 7 by 5 by 10 ft., or 350 cu. ft., that the air enters it at 140 deg. Fahr., and the number of cubic feet of heated air per hour at that temperature to be 38,500 with a small heater (see Table 3). We find from column C, Table 2, that 1,090 cu. ft. of air are required per pound of water. Thus for 100 lb. of water, 109,000 cu. ft. would be required. Hence the time taken, theoretically, to dry the blankets would be $\frac{109{,}000}{38{,}500}$ hours, or about 170 minutes, if the "used" air be saturated. In practice, the air will not become saturated, so this time should be doubled. A large heater,

TABLE 1. TEMPERATURES REQUIRED FOR DRYING DIFFERENT MATERIALS.

Drying.	Temperature Required (Deg. Fahr.).
Treated on dyed paper	150-220
Glued paper	160-300*
Glued tapes	160-300*
Pasted ribbons	160-200
Printing ink	70-300*
Felt hats	140-180
Glued ladies' hats	140-180
Matches	140-180
Macaroni	110-150
Photo prints	90-110
Photo negatives	90-110
Photo films	90-110
Feathers	150-180
Hair goods	150-190
Clothes	†
Drugs	†
Herbs	†
Barks	†
Pills	†
Furs	150-190
Size on paper	150-220
Bedding	150-190
Nuts	90-140
Cereals	110-150
Glassware	†
Hops	120-180
Rags	120-180
Overalls	120-180
Bathing suits	120-180
Blankets	140-180
Knitted fabrics	140-180
Gut	150-200
etc., etc., etc.	

* Can be dried at any temperature under 300 deg. fahr., that it is convenient to use.
† Depending on nature.

which has double the capacity of the small, will do the same work in half the time or twice the work in the same time.

It is interesting to note that this method of calculation checks up with the first method. Thus: 109,000 cu. ft. in 170 minutes, is equal to about 650 cu. ft. per minute. The heater has a capacity of about 650 cu. ft. per minute. The dry-room has a volume of 350 cu. ft. which thus allows about two changes of air per minute; or, with the greater allowance advised as a "factor of safety" and if the air were doubled, there would

TABLE 2. MOISTURE REMOVING CAPACITY OF AIR

A	Entering Heater Saturated at 70 deg. fahr. B	C	Entering Half-Saturated. (50% Relative Humidity) at 70 deg. fahr. D	E
Temp. of air entering Dry-room, deg. fahr.	Water-carrying capacity of air. Grains per lb. of air.	Cu. ft. of air (at saturation) required per lb. of water vapor.	Water-carrying capacity of air. Grains per lb. of air.	Cu. ft. of air (at saturation) required per lb. of water vapor.
80	11.6	8240	28.6	3300
90	23.9	4050	39.7	2380
100	36.3	2640	51.2	1845
110	48.8	1965	62.5	1515
120	61.8	1525	74.5	1270
130	74.8	1280	87.0	1085
140	87.8	1090	99.5	950
150	101.8	934	112.0	845
160	116.3	827	125.0	755
170	130.8	732	138.0	685
180	145.3	662	151.0	625
190	159.8	600	164.5	575
200	174.3	562	178.5	530

be 3½ to 4 changes of air per minute, which checks with the estimate of 2 to 5 changes per minute previously made.

To calculate the volume of air at any gas consumption other than the maximum, the following formula may be used:

$$C = \frac{E}{A_2} \times B \times G \times K.$$

Where C = Capacity in Column F;
E = Value shown in Column E;
A_2 = Value shown in Column A_2;
B = B.t.u. per cubic feet of gas;
G = Gas consumption in cubic feet per hour;
K = A constant depending on the efficiency, which is high at low temperatures and gradually falls from 90 per cent. at 80 deg. Fahr. to 75 per cent. at 300 deg. Fahr. 80 per cent. is a fair average. Therefore, use K as 0.8.

The following points on drying by this method are of interest. In the first place, heated air in motion is the cheapest and most efficient drying medium; it will absorb any kinds of moisture, vapors, or gases. The effect of the weather on this method is negligible; it can be used all day and every day. Cold, natural air,

TABLE 3. PROPERTIES OF SATURATED AND DRY AIR.[1]

(Under Standard Atmospheric Pressure = 29.921 in. of mercury)

A_1 Temp. of air delivered from air-heater.	A_2 Temp. Rise assuming heater = Inlet temp. 70° F.	B Weight of 1 cu. ft. dry air lb.	C Weight of 1 cu. ft. saturated air lb.	D B.t.u.'s absorbed by 1 cu. ft. air per sat. 1° F.	E Cu. ft. sat. air warmed 1° F. per B.t.u.	F Approximate capacity in cu. ft. heated air per hr. with 625* B.t.u. gas. F_1 Small heater.	F_2 Large heater.
70	0	0.07495	0.07425	0.01811	55.22		
80	10	0.07356	0.07253	0.01788	55.93	250,000†	500,000†
90	20	0.07222	0.07094	0.01763	56.72	87,500†	175,000†
100	30	0.07093	0.06922	0.01737	57.57	86,000†	172,000†
110	40	0.06968	0.06743	0.01716	58.27	65,250†	130,500†
120	50	0.06848	0.06553	0.01696	58.96	53,000†	106,000†
130	60	0.06732	0.06353	0.01681	59.50	44,500	89,000
140	70	0.06620	0.06133	0.01669	59.92	38,500	77,000
150	80	0.06510	0.05894	0.01663	60.14	34,000	68,000
160	90	0.06406	0.05637	0.01664	60.10	30,000	60,000
170	100	0.06304	0.05349	0.01671	59.85	26,900	53,800
180	110	0.06205	0.05029	0.01682	59.45	24,300	48,600
190	120	0.06110	0.04674	0.01706	58.80	22,000	44,000
200	130	0.06018	0.04275	0.01750	57.15	20,000	40,000
260	180	0.05516		0.01343	74.46	18,000	36,000
300	230	0.05225		0.01274	78.50	13,000	27,000
360	290	0.04800		0.01189	83.50	10,000	20,000

† Special. Made to order.
* If gas is not of 625 B.t.u. per cu. ft., multiply the capacities given by B/625, where B = the B.t.u. of the gas per cu. ft.
[1] Columns F_1 and F_2 show air heater and blower capacities.

even on a fine day, takes from six to thirty times as long as air supplied this way; it will accomplish in a day what would take a week by ordinary drying methods.

Most important is the absolute temperature control easily maintained with this system of drying. From Table 2 it is evident that the drying temperature may vary considerably for the same substance. The form and nature of the material being dried will frequently govern the temperature at which the operation is being conducted. The air-heater is so easily manipulated that the temperature at which a definite drying problem can best be conducted may be determined after the installation has been made.

Certain substances, if dried too rapidly, form a hard skin on the surface and thus prevent moisture in the interior from coming out. These require special treatment in governing the temperature and time needed

for the work. To obtain good results, the air supply pipe must be manifolded in the dry-room and the air directed against all parts of the product to be dried.

It is evident that is is possible to deliver the heated air so that it may be used for drying products in the dry-room which will materially affect the rate of drying. This should be borne in mind. For instance, if blankets or other goods be placed in a heap on the floor, so that air cannot reach the innermost parts, their drying may be a matter of hours instead of minutes.

It is hoped that the brief outline of this subject will provide value to those who have followed it and that the ideas given will be beneficial in enabling business to be obtained in this almost untouched but limitless field.

BIBLIOGRAPHY OF DRYING PRACTICE.

Title.	Author and Publisher.
The Application of Gas to Dry Room Equipment.	Chapple, C. E.: The National Commercial Gas Association, 61 Broadway, New York, N. Y.
Air Heaters (Bulletin No. 900)	The Improved Appliance Company, 455 Kent Avenue, Brooklyn, N. Y.
Bulletin WB235 Psychrometric Tables, etc	U. S. Department of Agriculture.
Common Sense Moist Air Dry Kilns	B. F. Sturtevant & Co.
Drying by Means of Air and Steam	Hausbrand, Eugen.
Drying Machinery and Practice	Marlow, T. G.
Fan Engineering	Buffalo Forge Co.
Practical Treatise on Heat	Box, Thomas.

Also see various engineers' hand books, such as Kent, etc.

Results of Recent Researches on the Constitution of Coal

Determinations of R. V. Wheeler and D. T. Jones Disagree with Those of E. Terres, which would Indicate that Study of Substance by Means of Solvent Is Comparatively Fruitless

The constitution of coal has been the subject of many investigations in recent years, notably by R. V. Wheeler and various collaborators in England, by M. Aimé Pictet and colleagues in France, and by F. Bergius in Hanover. The starting point of many of these investigations has been the extraction of the coal by certain solvents, especially pyridine; and work in this direction has been carried farthest by R. V. Wheeler, in collaboration with D. T. Jones, asserts the *Journal of Gas Lighting and Water Supply*. The work was carried out in the laboratories of the Home Office Experimental Station at Eskmeals, Cumberland. In the "Journal für Gasbeleuchtung" of Oct. 7, 1916, there is a paper by E. Terres, on "The Combination of Nitrogen in Coal and Coke," which is a communication from the Chemical Technical Institute of the Technical College at Carlsruhe, in which some of the more recent German work on the constitution of coal is reported and discussed.

Dr. Terres states that the nearly complete insolubility of coal in all solvents except strongly oxidizing acids has made this method of investigation, which with other materials has proved so successful, of very little service. The less reliable method of study by analogy has therefore been followed by many, and has yielded some useful conclusions. Gumbel's investigations of the cell structure of coal, made with the aid of the microscope in 1883, definitely traced the origin of coal to the conversion of the substance of plants, chiefly cellulose, into coal substance. This has been effected principally by formation of carbonic acid and water from the oxygen of the cellulose or plant substance, which accounts for the relatively small proportion of oxygen left in coal. When the oxygen has fallen to a very small proportion, as in anthracitic coals, the hydrogen becomes reduced by the splitting-off of methane and hydrogen, and true anthracite results.

Source of the Nitrogen in Coal

There is another constituent of coal—viz., nitrogen—which, though present in relatively small amount, is never entirely absent. Peat generally contains 0.9 to 2 per cent. of nitrogen, but in rare instances as much as 4 to 6 per cent., while in coal proper the nitrogen very rarely exceeds 1.75 to 2 per cent., and in anthracites it generally amounts to 1 per cent., though not infrequently it falls to one or two tenths of one per cent. It is noteworthy that in one and the same seam of coal, the nitrogen fluctuates much more than the other constituents—viz., by as much as 20 to 25 per cent. of its amount. What is the source of the nitrogen in coal? Wood never contains more than 0.1 per cent., which is also the proportion in bog vegetation. Yet even the youngest conversion product—peat—contains ten to twenty times this proportion; so that clearly the nitrogen in wood and plants is not sufficient to furnish the higher proportion found in peat and coal.

It must be assumed that the greater part of the nitrogen in coal is ultimately derived from the atmosphere, through animal remains mixed with the vegetable matter. Thus the nitrogen would come chiefly from albuminoid organic substances, and would be present in coal in the form of complex organic compounds. This theory would be strongly supported if albumin, or the amido groupings which result from its decomposition, were discovered in coal. Rau and Christie in 1908 detected the presence of amido groupings in peat and prepared humic acid, by means of the distinct smell of isonitril which was produced on treatment with potassium ethylate and chloroform. But they could not detect albumin itself in peat, nor amido groupings in other types of fuel.

Distribution of Nitrogen in Carbonization

In the carbonization of coal, the nitrogen appears as free nitrogen, ammonia, and cyanogen, and in some form in which it is unaffected by high temperature in the coke. Cyanogen probably results from certain secondary reactions. Drs. H. & K. Bunte have studied the distribution of the nitrogen in the carbonization of many coals, and, while it is affected by the heat and duration of carbonization, it may be said that, generally speaking, 40 to 65 per cent. of the nitrogen is found in the coke, 10 to 14 per cent. is recovered as ammonia, and the remainder is found as elementary nitrogen, as cyanogen, or in the tar. It seems probable that the whole of the nitrogen split-off is initially in the form of ammonia, and analyses of samples of the gas liberated at different stages of carbonization show that the ratios of ammonia, nitrogen, and hydrogen are in fair agreement with the equilibrium constants for the prevailing temperature. Very slow distillation of coal, which allows of complete exhaustion of the gas at each stage with a gradually increasing temperature of distillation, has been found by Rau and Christie to give as much as 35 per cent. of the nitrogen in the form of ammonia.

Dr. Terres carbonized a number of pure nitrogen compounds in a porcelain tube heated electrically to 700

to 900 deg. cent. with a view to ascertaining which nitrogen groupings yielded ammonia. The compounds taken were: Glycocol, asparagin, albumin, pyridine, azobenzene, hydrazobenzene, acetonitril, phenylisocyanate, and nitrobenzene. They represented the amido and substituted amido groupings, and the azo, hydrazo, nitril, isonitril, and nitro groups.

The ammonia and free nitrogen produced were determined, as was also the nitrogen in the residual coke. It was found that only the amido and substituted amido groupings were capable of splitting off ammonia and it may therefore be concluded that the nitrogen of coal is thus combined, and that it must originally have been of an albuminoid character. It appeared probable that if the nitrogen were in some simple combination, extraction of coal would give an extract containing a higher proportion of nitrogen than the residue. A finely powdered Saar coal (Heinitz), containing 1.15 per cent. of nitrogen, was extracted with benzene, chloroform, paraxylene, and pyridine; and the nitrogen in the residues and (except in the case of pyridine) in the extracts was determined.

The results proved that the nitrogen of the coal showed a preference for extraction. Further larger scale investigations, including extraction under pressure, have been interrupted by the war. So far amido groupings have not been detected in the extracts.

The Nitrogen in Coke

The greater part of the nitrogen of coal is found, on carbonization, in the coke, in which it is contained in a form in which it resists expulsion at a temperature of 850 deg. cent., and the investigation of which is a very difficult problem. Above 850 deg. cent., the nitrogen is slowly split off from coke, and to an increasing extent as the temperature is raised, until, at 1400 to 1500 deg. cent., the greater part of the nitrogen has been expelled. At 1800 deg. cent., Rau and Christie obtained a coke free from nitrogen.

The nitrogen can only be in combination with carbon —probably as a nitride of carbon, and these investigators, after many efforts, produced an artificial coke, by the decomposition of gaseous cyanogen by heat, in which there were 11.6 parts of carbon to one part of nitrogen. This product withstood a high temperature, though at temperatures from 960 to 1,350 deg. cent., it was decomposed into its elements rather more quickly than the coke compound of nitrogen. The nitrogen was given off in the free state.

Dr. Terres investigated the matter by observing the behavior of the nitrogen of coke under the action of steam at high temperatures, because a nitride, if present, would in these conditions generally yield ammonia. A well carbonized coke, of exactly determined composition, was gasified at different temperatures in air to which precisely ascertained quantities of steam were added. It was found that the yield of ammonia increased as the quantity of steam was increased; the best temperature being 800 deg. cent. Sachs succeeded, by drawing off the gases before decomposition of the produced ammonia took place, in recovering over 89 per cent. of the nitrogen of the coke in the form of ammonia. This result strongly supports the view of Rau and Christie that the nitrogen exists in coke as a nitride of carbon.

Action of Solvents on Coal

While the Carlsruhe chemists think that the study of coal by means of the action of solvents on it has proved comparatively fruitless, it is evident from the results of the work of R. W. Wheeler and his colleagues that this is not the case. Messrs. Jones and Wheeler point out that extraction of the dried coal with pure dry pyridine leaves an insoluble residue consisting mainly of cellulosic constituents.

If the pyridine extract, after removal of the pyridine, is extracted with chloroform or benzene, a further residue of cellulosic compounds is obtained, while the extract consists of resinous compounds. This extract differs from both the cellulosic residues, in that it softens at 100 deg. cent., whereas they are infusible, and it undergoes oxidation on exposure to air, exerting photochemical action on a sensitized plate, as resins do, whereas they do not; also it yields on distillation in a vacuum gas differing markedly in quantity and composition from the gas produced from them in the same conditions, and it yields a large quantity of liquid distillate or tar, which is free from phenols, whereas they yield small quantities consisting almost entirely of phenols.

The residues from the pyridine extraction and from the chloroform extraction of the pyridine extract behave similarly in all these respects, and both consist clearly of cellulosic compounds.

Nature of the Cellulosic Constituents

Boudouard, in 1909, showed that unchanged celluloses were practically absent from bituminous coal, the cellulosic compounds present being degradation products of the original plant celluloses, and resembling cellulose in yielding phenols on destructive distillation.

The production of phenols is due to the presence of the furan grouping, which is more stable than the cellulose molecule and would remain unchanged when the latter underwent degradation changes. Probably the cellulosic constituents of coal do not comprise many types of compounds. It is possible that in some of the cellulosic derivatives molecules approximating in structure to the carbon molecule may have resulted from the cellulose grouping.

Absence of Free Carbon in Coal

The agencies which have produced coal are bacterial decay, heat, and pressure. It is highly improbable that micro-organisms can have effected a segregation of free carbon, while it is equally improbable that coals in general can ever have approached during their formation a temperature as high as 300 deg. cent., which is too low to effect complete carbonization.

Pressure is adverse to molecular disintegration, so that it is unlikely that these factors, singly or together, can have brought about the complete carbonization of any portion of the mother substance of coal. But there are similarities of behavior between carbon and coal, which indicate that the latter contains molecules similar in type to the carbon molecule—*i.e.*, a structure involving a six-carbon ring, and containing the fluorene grouping.

The Resinous Compounds in Coal

The resinous or resinic compounds comprised in the chloroform extract of the pyridine extract of bituminous coal have presumably been derived from the gums, resins, starches, sugars, etc., in the original plants. They comprise compounds containing residual alkyl, naphthene, and unsaturated hydro-aromatic radicles attached to larger and more complex groupings. The compounds

(*Continued on page* 110)

AMERICAN
GAS ENGINEERING JOURNAL

FIFTY-EIGHTH YEAR

Published Weekly by
AMERICAN GAS LIGHT JOURNAL, INC.
42 Pine Street, New York, N. Y.

ELBERT P. CALLENDER, President
STANTON G. KRAKE, Vice-President
FREDERICK A. SOUTHWORTH, Secy.-Treas.

EUGENE C. MILES, Editor

Subscription, $3.00 per year, including postage in the United States, Mexico, Cuba, Porto Rico, Hawaii or the Philippines.
In Canada, $4.00. Foreign, $5.00

Entered at the Post Office, New York City, as Second Class Matter.

CONTENTS

ADVANTAGES OF GAS FOR PRODUCTION OF VARNISH MAKE ITS INSTALLATION HIGHLY ADVISABLE IN MANY CASES, by Henry L. Read..... 97
ADOPTION OF NEW RATE SCHEDULE BRINGS MANY ADVANTAGES TO MARTINSBURG GAS COMPANY, by Leon H. Ware..... 99
GAS-FIRED FURNACE SUPERSEDES COKE FOR FRYING POTATO CHIPS..... 100
CAMDEN BENZOL PLANT WILL TAKE CARE OF ALL GAS DRIP FROM SOUTHERN NEW JERSEY.... 101
ARTIFICIAL DRYING AN ALMOST LIMITLESS FIELD FOR USE OF GAS..... 103
RESULTS OF RECENT RESEARCHES ON THE CONSTITUTION OF COAL..... 106
EDITORIALS 108
PATENTS PERTINENT TO GAS INDUSTRY..... 111
SPECIAL ENGLISH CORRESPONDENCE..... 113
NEWS OF THE GAS INDUSTRY..... 115
SOCIETIES AND ASSOCIATIONS..... 119
CONSTRUCTION NOTES..... 120
PERSONAL NOTES..... 120
FINANCIAL NOTES WILL BE FOUND ON PAGE 16 OF THE ADVERTISING SECTION.....

The Sliding Scale for Small Towns

There can be no doubt as to the advantages of a sliding scale of rates as a means of increasing gas sales. There can be little doubt, likewise—providing of course, that the schedules are properly figured—as to the favorable effect of such a system on gas company earnings. We will go further and assert that there can be no doubt that, sooner or later, the sliding scale system will be generally adopted by the gas companies in this country.

Elsewhere in this issue we publish an article on the beneficial effect of establishing such a system in a community of somewhat over ten thousand population. Gas companies serving communities of such size, and even considerably larger, should read this article carefully. There is a lesson contained in it. The distribution systems of most communities of such size can handle a considerably larger output than they are at present handling, or could be enlarged sufficiently to do so at a reasonable expenditure, and with very little inconvenience to the general public. It would seem that the day of the sliding scale rate for such communities is not very far distant.

There are many factors involved, however, in its adoption by large cities that have to be carefully considered.

Take, for instance, a city of say close to a million population. The gas company is doing a large lighting and cooking business, and a certain proportion of industrial business. Say this company suddenly adopted a rate for house heating that would put gas on a basis not greatly in excess of coal, and inaugurated an energetic publicity campaign to secure such business. Is it not quite conceivable that its gas sales could be quickly doubled and even trebled? The recent experience of the Baltimore company with its 35-cent rate furnishes us a good index as to what we might expect along these lines.

What would such a condition bring about in the way of new construction? The present distribution system would have to be practically doubled overnight. The city's streets would be torn up almost in every block; traffic would be interfered with; from want of proper supervision, the work would not be of equal quality with existing construction, and the company's organization would be demoralized throughout. The first condition would place a heavy tax on the public's attitude towards the gas company and the effects of those that follow would be equally deplorable.

There are more reasons than one why such companies have not rushed headlong to adopt every plan urged upon them for increasing their gas sales. The gas industry represents no mushroom-like growth. Its keystone is permanence. It has not been in the habit of placing a tax on its systems, but rather of building up the systems and securing the business as they did so. There is less expense and, conse-

quently, more profit attached to one satisfied customer than to a dozen dissatisfied ones.

The managements of all our gas companies in general are progressive, and have been for almost a hundred years. But they have too much pride in their industry and are too faithful in their allegiance to it to undertake more than they can handle, or to start off at a steam-engine rate along some particular line of extension; then abruptly come to a stop upon discovering that their facilities are not adequate to handle the business they are making such energetic efforts to obtain.

Complaints

In a recent article in *Printers' Ink* written by Frank Leroy Blanchard under the title, "The Winning Fight of Newspapers Against Inaccuracies," are the following two rules which were laid down by Bradford Merrill for the guidance of the New York *World* editorial staff: "All complaints must be investigated at once upon reeipt, and, if the *World* is found to be at fault, a correction must be printed forthwith; all corrections must be frankly and fully made—half-hearted or equivocal statements are not permitted."

Mr. Merrill is also quoted as follows:

"One reason why publishers formerly refused to rectify mistakes was the old-fashioned theory that the printing of corrections would weaken public confidence in their reliability. In my opinion this is not true. The prompt acknowledgment of error is an evidence of a desire to be just and do the right thing by those who may have been harmed by the published misstatement."

These rules and this statement are of interest to gas men because the past experience in the newspaper field in regard to complaints has apparently been similar to that in the utility field. Where the two rules quoted above are being applied in this field excellent results are being secured. It is found that prompt investigation of complaints and correction of any errors made by the company creates a feeling of good-will which is perhaps greater than it would be if no errors had been made and afterwards corrected.

Most important of all, however, it is found that when the company is in the wrong it is necessary to make a full and a frank statement to the complaining consumer in regard to the complaint. In other words, the spirit in which the complaint is handled is fully as important as the final settlement that is made.

To take an example. Suppose a citizen complains that one of his shade trees has been killed by gas. If the man to whom he makes his complaint tries to persuade him that gas never kills shade trees and he finally is awarded damages for the tree, he has no kindly feelings towards the gas company. On the other hand if, as soon as he makes his complaint, an investigation is started to ascertain just what did cause the death of the tree, though he may never receive a penny from the gas company, he will probably find out what did cause the tree to die and he will always feel much more friendly towards the company on account of the interest it has taken in his complaint.

Sincerity and frankness have greatly assisted city newspapers in building up their circulations and their reputations. It also pays the gas company who adopts this policy by increasing the good-will and the gas consumption. Incidentally it also increases the dividends paid to the stockholders.

Montana Commission Takes a Hand in Discouraging Industrial Enterprise

Should a gas company see fit to raise or abolish an industrial rate that tended to attract manufacturers to its territory this journal would consider the step injudicious and bad business policy, but it could understand the motives behind it. There are some managers who are not so broad of vision as to see beyond the obvious, and to realize that each individual added to the population of its territory makes its franchise to at least an infinitesimal degree of more real value, and it is a small industry that will not add more than one individual to the population of a community. But when a municipality or a state body takes a step towards such a condition, we confess our utter inability to comprehend the line of reasoning that must have led up to it.

The Natural Gas Company at Havre, Mont., had in effect an industrial rate which apparently had attracted to its city a certain number of industrial enterprises. The company was willing to continue the rate. Evidently it had found a profit in it. But the State Public Service Commission has stepped in and ordered a substitute, which, according to an official of the gas company, it is feared "will not only interfere with the factories now working under the old rate, but will have a tendency to discourage any manufacturer who might consider locating in Havre."

Our ideas as to present-day conditions in Montana are somewhat vague. Still we do not believe the state has by any means reached the point of saturation in the matter of population. When the Board of Trade of a mushroom-like city like Bridgeport in a thickly-populated little state like Connecticut seems to consider the attracting of industries to its territory of such importance to the welfare of the community that for miles around it trumpets its claims as an industrial center, it would seem that a few more factories should contribute considerably to the prosperity of any city in the state of Montana. If it were the gas companies, following a short-sighted policy, that were discouraging their advent—as has been stated—we could understand it. But the reasoning behind such an attitude on the part of a public body is incomprehensible.

(*Continued from page 107*)

obtained as low temperature distillates of coal are for the most part decompostion products not present in a free state in coal, and, according to the authors' hypothesis, resulting from "bound" molecules.

This hypothesis, however, would not account for aromatic compounds, corresponding by analysis with dimethylnaphthalene, distilling from coal at a temperature of 300 to 350 deg. cent. Their formation by elimination of hydrogen from hydro-aromatic compounds is unlikely, but may be due to the splitting-off of a radicle with hydrogen from hydrogenated nuclei. As regards the oxygenated compounds in the resinous constituents of coal, the indifference of coal to saponifying and hydrolyzing reagents makes it improbable that much of the oxygen is in the hydroxylic or carboxylic grouping.

The Hydocarbons in Coal

The presence of traces of free hydrocarbons in coal has been proved by the extraction of hexahydrofluorene, melene (a solid naphthene, $C_{30}H_{60}$), and heptacosane (a solid paraffin, $C_{27}H_{56}$). Further, coal must contain hydrocarbons in a bound state, from which they are liberated on distillation. Similarities in naphthenes derived from coal and certain petroleums point to the presence in the parent substances of both coal and petroleum of compounds, such as aliphatic esters, which are common to both vegetable and animal remains. Phenols, derived from the cellulosic constituents of coal, are always present in the distillates from coal, but not in petroleum and its distillates. This points to the parent substance of petroleum having been free from material of cellulosic structure, and is evidence in favor of the non-vegetable origin of petroleum.

Extraction of Coal under High Pressure

The investigation of the extraction of coal under high pressure, which Dr. Terres stated had been interrupted by the war so far as the Carlsruhe laboratory was concerned, has been pursued by other German chemists: F. Fischer and W. Glund, who have reported their results in a recent number of the *Berichte* of the German Chemical Society. They used a special autoclave, and in most cases benzene as the solvent, working at a maximum temperature of about 275 deg. cent., which, with benzene, corresponds with a pressure of about 55 atmospheres. In these conditions, as much as 6.6 per cent. of ordinary bituminous coal was extracted in five successive extractions, though the residue did not differ greatly in appearance from the original coal. Half of the extracted substance went solid at ordinary temperatures.

Lignite in the same conditions gave up to the solvent 25 per cent. of its weight in three successive extractions, but there was considerable decomposition of the lignite, with evolution of sulphur compounds. Cannel yielded only about 4 per cent. of extractable substance.

The same chemists have made some extractions of coal with naphthalene at 350 deg. cent., at which temperature there is considerable decomposition of the coal and an extraction of 25 to 30 per cent. of its weight. They also attempted extractions with liquefied sulphur dioxide at low temperature, which broke up bituminous coal to a powder and gave an extract nearly free from solid matter, while scarcely attacking anthracite and cannel. The extract from lignite with benzene at 275 deg. cent., is a mixture of a resin with a wax; but the sulphur dioxide extract is resinoid only.

Franz Fischer has also studied the effect of submitting coal suspended in water to a stream of ozone, and has found that the coal is gradually almost completely dissolved. The resultant dark-colored solution is strongly acid, which is probably due to a secondary reaction between the water and the ozonides of the coal substance.

Use of Cast Iron for Fittings, Radiators, etc., Daily Becoming of Greater Importance to Heating Engineer

The use of cast iron for fittings, radiators, tempering coils and boilers is becoming daily of greater importance to the heating engineer, is the assertion made in the January *Journal* of the American Society of Heating & Ventilating Engineers. The complicated castings required in some of the appurtenances named above are being made with greater precision than ever before, the United States having had for a great many years the leadership of the world in this respect and is no doubt maintaining this leadership. We think nothing of putting an ordinary radiator or a boiler under a pressure of 50 lb. per sq. in., as in the ordinary domestic hot water heating system, pressures that are considered by many engineers prohibitive for use for cast iron.

It is to be regretted therefore that nothing seems to be done to still further develop the use of cast iron in our heating, particularly in places where corrosion is mostly to be feared. Many pipe lines forming part of a heating sytem could for durability's sake, be made of cast iron, because simple flange joints could be used and even threaded joints might be developed. Indeed, entire hot water heating systems have been put together in Russia, of cast-iron pipes. Consider for instance the universal practice of heating greenhouses in England, France and Germany, of some 25 to 50 years ago! Ordinary 4-in. diameter cast-iron pipes put together with clamps and rubber gaskets were used. No matter how many times a day these pipes were sprayed with water, summer and winter, heat or no heat, the pipes would last for decades.

Interesting Employees in Quality of Product

For the purpose of stimulating interest among employees in the products on which they work, a number of important companies in the Central West have adopted an effective method devised by their advertising manager, G. P. Blackiston, of Canton, Ohio, states the *Iron Age*. On the factory bulletin boards various full page advertisements are posted, generally with illustrations, all under the legend, prominently displayed: "We depend upon you to back up these advertisements." In connection with the advertisements themselves is an additional expedient for enlisting the interest of the employee who reads. Typewritten pasters affixed to the advertising page contain sentiments like the following:

A strong statement, but we feel you are able to back it up, providing you put forth your best efforts.

A small mistake on your part means useless advertising on our part.

We have to sell more than the mere product itself to-day. We must give service. Help us to give it.

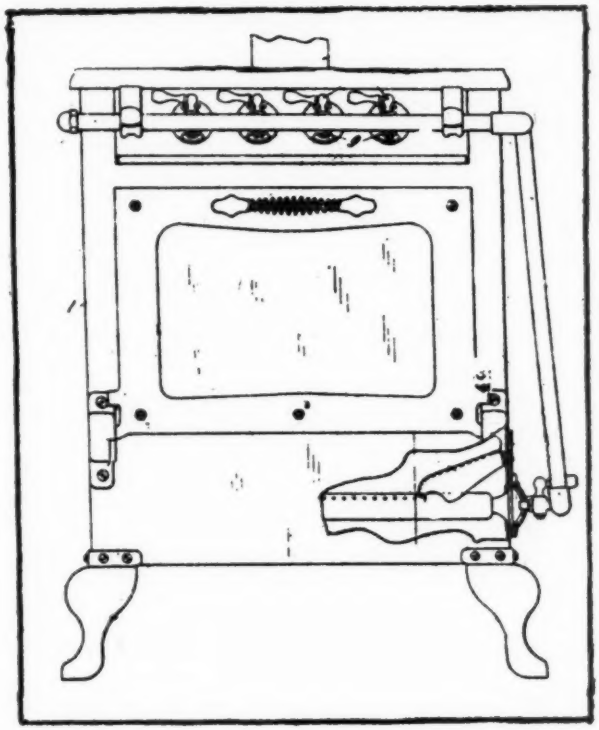
Our product is no better than the care you exercise in its handling. Are we making the best?

Patents Pertinent to Gas Industry

Inclined Plate Is Used to Ignite the Oven Burners On This Gas Range

Patent No. 1,208,166; described in Patent Office *Gazette*, 12-12-16, page 524. Frank V. Knauss, Portsmouth, Ohio. Filed Aug. 30, 1915. Serial No. 47,930. (Cl. 158-115.)

An inclined plate, having a channeled under-surface, straddles the burner at one end and at the other end terminates at a hole in the side of the range. The gas



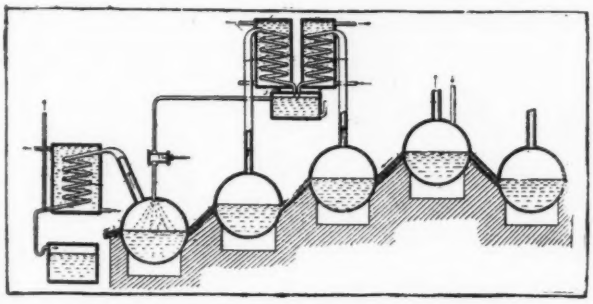
ARRANGEMENT OF INCLINED PLANE FOR IGNITION

is turned on and lighted at the hole in the range and this ignites the gas at the burner by the propagation of the flame down the underside of the inclined plate.

Apparatus for Converting the Heavy Products Obtained from Petroleum

Patent No. 1,208,214; described in Patent Office *Gazette*, 12-12-16, page 541. Pedro Roth and Máximo Eduardo Venturino, Buenos Aires, Argentina. Filed Oct. 16, 1916. Serial No. 126,058. (Cl. 196-25.)

This apparatus consists of a series of boilers arranged in battery, every two successive boilers being connected. The boilers are heated and the vapors and gases of distillation are discharged from each boiler. The vapors and gases are condensed, the heavy or middle hydrocarbons being freed from the water and impurities which they may contain. The liquid heavy or middle hydrocarbons are introduced under pressure



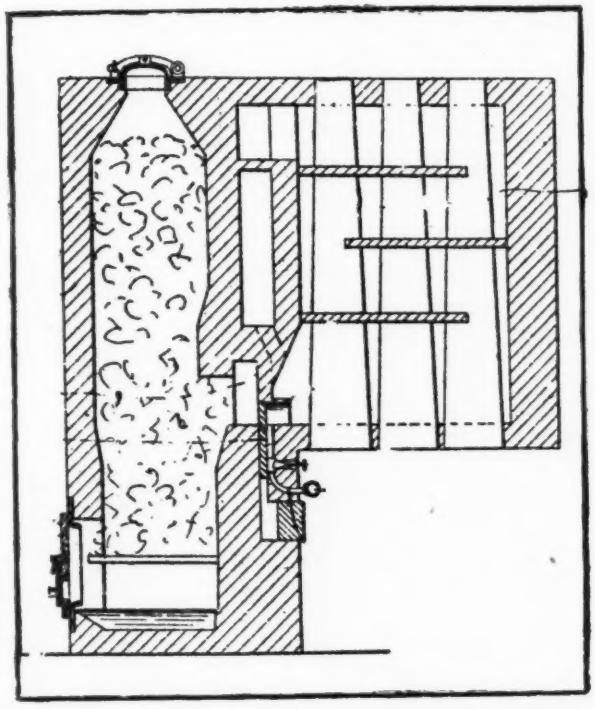
EVERY TWO SUCCESSIVE BOILERS ARE CONNECTED

into the vapor space of the lowermost or converting boiler. A sprayer discharges the middle hydrocarbons into this last boiler whence they are vaporized and condensed in a separate vessel.

Both Illuminating or Producer Gas or a Combination of Both May Be Used for Heating Coke Ovens

Patent No. 1,208,134; described in Patent Office *Gazette*, 12-12-16, page 511. Rudolf Geipert, Berlin, Germany, assignor to Dessauer Vertikal Ofen Gasellschaft, Berlin, Germany. Filed April 10, 1914. Serial No. 830,925. (Cl. 110-31.)

This method of heating coke ovens consists of burn-



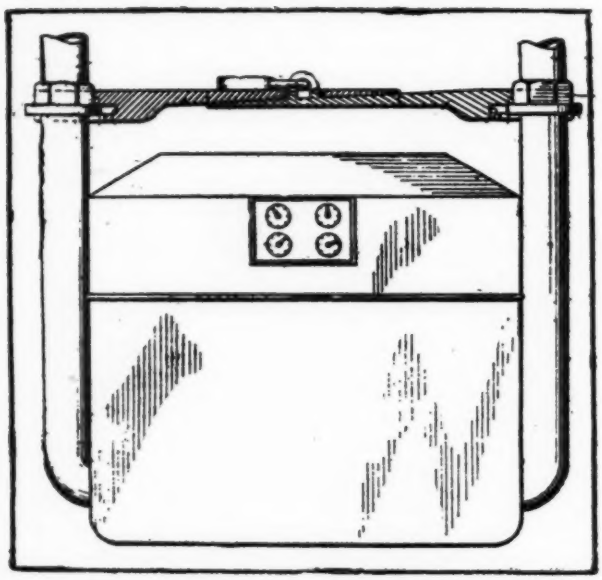
REGULATING FLUES ELIMINATE DANGER OF EXPLOSION

ing either gas generated in the producers or illuminating gas derived from the ovens. During the time that illuminating gas is being used, it is possible to continuously generate producer gas which may be mixed with the illuminating gas and burned to provide heat for the ovens. The possibility of explosion is eliminated during the cleaning of the producers by suitably regulating the flues for the admission of both illuminating and producer gas.

This Device Prevents Tampering With Gas Meter Connections

Patent No. 1,208,236; described in Patent Office *Gazette*, 12-12-16, page 549. Frank H. Thompson and Frank C. Thompson, Philadelphia. Filed Jan. 19, 1916. Serial No. 72,994. (Cl. 70-80.)

This device consists of two members, the outer ends of which are made with sockets which fit around the unions on the meter connections and which prevent the unions from being turned. Flanges which fit underneath the face of the unions prevent the locking members from being moved upward and away from the nuts. The inner end of one of the two locking members is equipped with a slot and with flanged edges, while the other member fits inside of the flanges and has a staple which projects through the slot in the first member. A lock, fastened to the staple, completes the equipment.

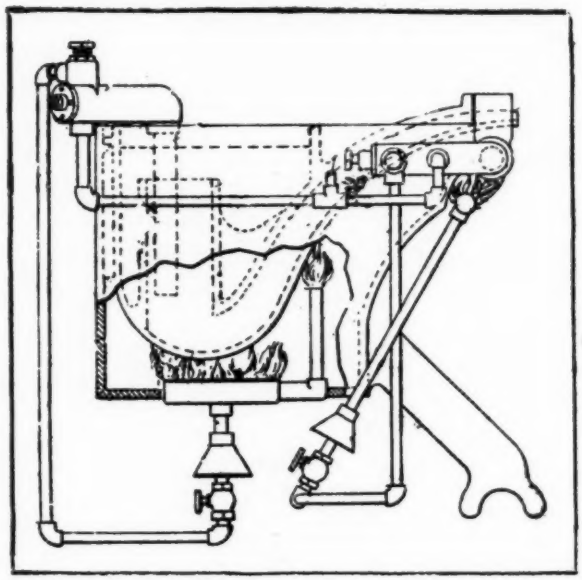


SHOWING FLANGE AND LOCK ARRANGEMENT

Meter for Measuring Flow of Fluid Balances Weight Against Impulse

Patent No. 1,208,602; described in Patent Office *Gazette*, 12-12-16, page 679. Harold H. Mapelsden, Schenectady, N. Y., assignor to General Electric Company. Filed Oct. 1, 1913. Serial No. 792,870. (Cl. 73-167.)

A movable vane extends into the pipe in which the fluid is flowing, and any movement is balanced by a counterweight mounted on a scale beam connected to the vane. The counterweight moves along the scale beam and counterbalances the force exerted by the fluid in the vane. The position of the weight is automatically adjusted so that the vane is held in substantially the same position in the pipe.



FLOW OF GAS CONTROLLED BY THERMOSTATS

Thermostats Used to Control Heat Supplied by Gas to Linotype Melting Pots

Patent No. 1,208,587; described in Patent Office *Gazette*, 12-12-16, page 674. George E. Lee, Cleveland, Ohio, assignor to The George E. Lee Company, Cleveland, Ohio. Filed June 1, 1915. Serial No. 31,343. (Cl. 22-71.)

Thermostatic couples extend into the portions of the pot which contains the melted metal, these couples actuating the operation of thermostats. The flow of gas to the burners is in turn controlled by these thermostats, so that an even temperature may be maintained throughout the operation.

No Nut or Screw Used on this Monkey Wrench

Patent No. 1,208,464; described in Patent Office *Gazette*, 12-12-16, page 631. Dailey Booth and John J. Douglas, Lexington, Ky. Filed Feb. 12, 1916. Serial No. 77,927. (Cl. 81-139.)

This wrench consists of a stationary jaw on an integrally formed shank, the shank having a longitudinally extending slot throughout its whole length, one side of the slot being a toothed plate. The handle of the wrench has a hole extending through its entire length, this hole opening into the slot of the shank. The shank of the movable jaw slides in the slot, the inner end being recessed to provide space for a spring pressed dog, which engages the toothed plate. A push member is connected to the dog, and a coil contact-tile spring, mounted in the hole in the handle, tends to keep the movable jaw tight against the fixed jaw. When the wrench is to be used, the dog is released, the shank pulled out to provide the desired opening, the dog engages the toothed plate, and the shank is held in an unmovable position.

Special English Correspondence

Monthly Letter from Norton H. Humphrys, Salisbury, Eng.

Sulphate of Ammonia as a National Asset. A Fatal Accident in Connection with Acetylene Welding. The Dehydration of Tar in Small Gas Works

The assistance afforded by gas undertakings, as the producers of benzol, toluol, and other substances that are largely in demand for the manufacture of explosives, is a matter of common knowledge, and a discussion in Parliament illustrates the position of another gas works, residual, in relation to the no less important problem of the National food supply. In the course of a debate on food prices, Sir Alfred Mond told the Government that they were practically exporting large quantities of food, not in a consumable form, but in the shape of nitrogenous manures. (He might have added that sulphate of ammonia can also be utilized for the preparation of nitric acid and other material used in the manufacture of explosives, and that it is within the bounds of possibility that some of the nitrogen produced in British gas works may find its way into German manufacturies, and eventually be used against our brave soldiers and sailors.) The Board of Trade had admitted that the land in Germany was producing, at present, much more food than before the outbreak of war, and that the increase was due to a more liberal use of artificial manures. It was not merely a question of increasing the extent of acreage under cultivation, which would necessitate a corresponding increase in labor and other things, but of increasing the production per acre on the land already in use. Not only had the Government done nothing in this direction, but were permitting the export of thousands of tons of sulphate of ammonia, the most valuable manure by which the wheat crop of the country could be increased to the extent of 50 per cent. It was not enough to send circulars and begging letters, the farmers should be systematically visited by experts, and might even be compelled to put down a certain amount of manure per acre.

Restricted Export Necessary

Mr. Acland, Parliamentary Secretary to the Board of Agriculture, said that special arrangements were made last year, by which the home farmers were able to obtain sulphate of ammonia at a specially low rate. They had absolutely prohibited export, for a space of two and a half months, and until there was a chance, or a threat, that on account of accumulation of stocks, some works would be compelled to discontinue the manufacture of materials that were absolutely vital to the Ministry of Munitions. When this was apparent, it was obviously necessary to allow restricted export to take place under control. Of the total production of 400,000 tons of sulphate of ammonia per annum, the home farmers took only 50,000 to 60,000 tons, but there was every prospect of about doubling the home consumption in the present season. If, with a class that was notoriously slow to move, they had doubled the consumption, it was scarcely fair to say that the Government had done nothing.

Results Outcome of Ten Years' Effort

The statement made by Sir Alfred Mond is true to a large extent, because the increased use of sulphate is not so much a result of special efforts made since the outbreak of war, as the natural outcome of the persevering efforts put forth by the Sulphate of Ammonia association, who have been working energetically over the last ten years or more, distributing literature, employing experts to lecture and visit in all parts of the country, offering prizes for crops grown off sulphate as a manure, etc., and much of the credit to which the Government lay claim is the fruit of this propaganda work, and is independent of public affairs. Since the war, the Association has loyally backed up and supported the Board of Agriculture, and is now engaged in intelligent propositions for the encouragement of the home use of sulphate, which at present are private to the members of the association.

Personally I have been fairly successfully in the development of a home demand for this residual, and for many years past have disposed of the entire make, at some gas works, within the bounds of the district. A start was made by obtaining certified analyses from the principals of local agricultural colleges, and these proved very effective amongst the younger class of farmers, who have attained a course at one of these institutions, and are acquainted with the chemistry of soils and manures. Many of them prepare their own mixtures according to analysis, instead of buying the ready made article, and are open to give intelligent consideration to reliable information. The older class of agriculturist still believes, to some extent, that anything with a color, a pronounced odor, (the more offensive, the better) and is cheap, is a wise investment. A clean, white, inodorous salt at about $72.90 per ton strikes him as something in the way of a fraud.

Residue of Light Oil Causes Fatal Explosion

The necessity for precaution against the presence of even apparently insignificant traces of inflammable gases or vapors, in pipes or receptacles about to be submitted to acetylene welding, was exemplified at Nuneaton Gas Works on the 7th ult., by the explosion of a steel barrel that had been used for containing light oil obtained in the dehydration of tar, which was attended with fatal consequences. Owing to the shortage of labor that is now the usual thing in gas works, the foreman, Mr. G. Knight, was personally engaged, with the assistance of a lad, in fitting two inch sockets to a number of steel barrels. These were for the most part dry inside, but one was found to be moist with a residue of light oil. It was filled with water, agitated, and emptied, under the impression that all risk of danger would thus be avoided, but that error of judgment cost the unfortunate foreman his life, while the lad

escaped without injury. The barrel was laid on its side with the vent hole open, and preparations made for burning out a two-inch hole for the reception of the socket. As soon as the heat of the flame struck through to the interior surface, a terrific explosion took place, wrenching off the two ends of the barrel, and inflicting such injuries on Mr. Wright that he died the next day.

The explosion was due to the formation of a mixture of air and inflammable vapor, in proportion within the "explosive limits," which vary, not only with the composition of the vapor, but according to the shape of the containing vessel, and the manner in which the igniting source is applied. Such a mixture has been observed, for instance, to fire more readily when the light is applied from below, than from above. The question for consideration is, "what is the minimum percentage of light oil vapor, that will represent the lowest explosive limit, assuming that the receptacle was charged with an even and homogeneous mixture?" This is believed to be in the neighborhood of two per cent. by volume. The content of the barrel in question was about eight cu. ft., so it is evident that something less than one-sixth of one cu. ft. of oil vapor would suffice to fill it with an explosive mixture. The specific gravity of such vapor is about three times that of the atmosphere, so one pint by measure, bulk 34⅔ cu. in. would yield approximately 4½ cu. ft. of vapor. One-twenty-seventh part of a pint, about 1¼-inch by bulk, or less than one fluid ounce by measure, would suffice to fill the barrel with explosive mixture.

Responsibility Lies with Slow Diffusion of Heavy Vapors

But heavy vapors diffuse very slowly. This fact is responsible for no end of accidents with air gas and acetylene, as it is dangerously deceptive to persons whose experience runs chiefly with coal gas, or other mixtures that do not exceed 0.5 in specific gravity. And one can conceive that the barrel need not necessarily be filled with an explosive mixture to cause a dangerous explosion. A smaller quantity than the trifle above named might be the medium of disastrous results. The interior surface of the barrel was about 12 ft. super, and there would be a 6¼ ft. run of angle at each end. It is easy to see that such a vessel might obstinately retain, spread over the interior surface, one cu. in. of oil, even after energetic rinsing out and prolonged exposure with the vent open. Obviously very great caution should be used in approaching with the acetylene flame, any pipe or vessel that has been used for the reception of light oils, or for carrying gases that might be expected to leave a coating of such oils behind.

Dehydration of Tar Attracting Much Attention

The dehydration of tar in small gas works has attracted much attention lately, and that for more than one reason. First there is the National demand for benzol and other constituents of the light oils, which must be met, if necessary, without regard to the usual commercial considerations. Then there is the fact that, this demand notwithstanding, the effect of the action of the Government in forbidding the sale of crude tar for use on roads or for asphalt making, and generally discouraging its sale for any purpose other than distillation, before adequate provision had been made for dealing with the large additional quantity thus thrown on the market, enabled the distillers to be masters of the situation, and to adjust the market value of tar to their own liking, without any consideration for the numerous extra burdens now endured by the producers. Many small gas works have not been able to obtain more than ¾d per gallon, net, for their tar. There is nominally a sort of arrangement under which a premium is paid for extra benzol or toluol content secured by oil or tar washing, but in many cases it is an absolute farce, and even where the full value is allowed, receipts for tar are less than in pre-war days.

At a recent meeting of the South West of England Association of Gas Engineers, which represents a large proportion of small works, Mr. Pye, of Clevedon, said he had lately erected a Wilton apparatus capable of dealing with 70 gallons of crude tar per hour. The complete cost, inclusive of shed, pumps, storage tank, etc., was $1,458, and the plant was simple, efficient, and easy in working. The yield of products was 12 to 18 gallons of light oils, 5 of water, (i. e., ammoniacal liquor that could be returned to the liquor store well), and 75 to 80 of dehydrated tar, per 100 gallons of crude. The light oil realized about $.09, and the refined tar, $.04 per gallon, after paying loading and carriage, and allowing $1.52 for working costs, the net receipts per ton of crude were about 30/—, as against 16/—offered by the tar distiller. One trouble was that the dehydrated tar prepared at the temperature recommended by the Ministry of Munitions, 230° C, was solid when cold and could not be handled in casks. If required in a liquid state, about 5 gallons of creosote oil must be mixed with 100 of dehydrated tar, or small quantities could be kept fluid by means of waste steam.

Mr. Wyatt of Seaton, a gentleman who has given much attention to the utilization of tar, deprecated the use of make shift, "home made" dehydration apparatus as not giving much satisfaction, and less profit. A good supply of steam, and plenty of water for cooling was essential, and without the aid of steam the dehydrated product could not be maintained in a fluid state, especially in the winter. The higher the temperature of distillation, the less the value of the light oil, and it was desirable to condense in two stages, because the temperature necessary to keep the naphthalene in a fluid state meant a loss of benzol by evaporation. The crude tar, preheated to 200° F. by passing through a steam jacketed delivery pipe, was admitted to the bottom of a small vertical internally-fired boiler or still, 4½ ft. high and 3 ft. in diameter, and after attaining a temperature of about 400°, passed off at the top to an expansion chamber consisting of a closed iron cylinder, 2 ft. high and 1½ ft. diameter, where it parted with the volatile portions, and the refined tar passed on to a store tank capable of accommodating at least a day's make. The condenser was in two sections, and the cooling water was first used for the lighter fraction, then the heavier, and finally for the dehydrated tar. The light fraction was stored in steel drums, and a mixture of 10 per cent. of creosote oil was required, to render the refined tar sufficiently fluid for road purposes. A small purifier charged with lime, —not oxide which might be liable to fire,—was desirable, for taking care of the non-condensable gases. The light oils sold for 9 to 13 cents per gallon, and the refined tar was worth exactly what it would fetch. All pipes should be jacketed in such manner that either steam or water could be used when required, and lagged with non-conducting material. A good day's work was the treatment of 400 gallons of crude, with a consumption of two cwt. of broken coke, and 1,000 gallons of water.

News of the Gas Industry

Committee Finds Price of Gas Reasonable

That this is an inopportune time to seek a reduction in the price of gas to consumers in Everett, Mass., is the conclusion at which the special committee appointed by the board of trade to look into the matter has arrived. The committee has held many meetings and conferences with the officers of the Malden and Melrose Gas Company, which supplies this district, and the findings are based on an exhaustive study of the subject.

In the committee's judgment the present abnormally high cost of three items which enter into the cost of producing gas, to wit: coal, gas-oil, and labor, make it unreasonable to demand a lower rate at this time.

The Malden and Melrose Gas Light Company serves six communities, viz.: Everett, Malden, Melrose, Medford, Stoneham and Reading.

The net rate to consumers in the first five is $.90 per thousand cubic feet.

The net rate to Reading is $1.50.

The margin of profit, at the present time, does not warrant any decrease in the rate charged.

Recommends Artificial Gas for Kansas City

Kansas City must eventually return to artificial gas and the advice of Henry L. Doherty, who recently purchased the Kansas Natural Gas Company, is that it begin preparing for that at once, as the natural supply is exhausted. Mr. Doherty spoke recently before the City Club of Kansas City.

"The gas muddle in which Kansas City and the forty partners of the Kansas Natural Gas Company to-day find themselves will be solved only by good fellowship, mutual understanding or a get-together spirit, but never by going to court," said Mr. Doherty.

"I am not much of a believer in courts, and we want the help of the public and the administration in untangling a bad situation.

"When the big field to the southwest was discovered everyone believed it to be inexhaustible, and gas was wantonly wasted. It is like every other gas field, big, but by no means inexhaustible. There is more than enough gas for two years to come.

"My belief is that you must come to this: You must substitute artificial gas for natural gas. And my advice is that you do that gradually. Start now. And I will stake my reputation on the statement that artificial gas can be produced cheaply enough to make it pay the consumer to use it for cooking and heating."

Combined Gas Sales of New York Consolidated and Affiliated Gas Companies Show 1,131,180,263 Cu. Ft. Increase Over Previous Year

Greatest Percentage of Increase in Westchester County and Borough of Queens—Consumption per Customer in the Bronx Shows Decrease, but Sales Due to Increased Population Offset Loss

The gas sales of the Consolidated Gas Company increased during the year 1916, as compared with the previous year, 615,301,300 cu. ft. or 3.92 per cent. In 1915 there had been a decrease in gas sales of 5.02 per cent. as compared with the previous year.

Its gas sales and those of its affiliated gas companies in the Borough of Manhattan increased during the year 829,207,600 cu. ft. or 3.83 per cent. as compared with a decrease of 5.38 per cent. in 1915.

In the Borough of The Bronx a decrease in the consumption of gas per consumer was offset by an increase in gas sales, resulting from the development of building operations in that territory; so that the gain therein during the year in the volume of sales amounted to 98,525,194 cu. ft. or 2.34 per cent. as compared with a loss of 0.70 per cent. in 1915.

In Westchester County and in the Borough of Queens, both of which are growing territories, the sales of gas increased during the year 203,447,469 cu. ft. or 8.52 per cent. as compared with a gain of 1.98 per cent. in 1915.

The combined gas sales of the Consolidated Gas Company and its affiliated gas companies in the Boroughs of Manhattan, The Bronx and Queens and in Westchester County amounted to 1,131,180,263 cu. ft. more than in 1915, a gain of 4.01 per cent. as compared with a loss of 4.12 per cent. in 1915.

Last year comparisons were made between the variations in the amount of gas, consumed in 1915, as compared with 1914, in all classes of establishments, including dwellings, apartment houses, stores of various kinds, factories, hotels and restaurants, for the purpose of ascertaining, if possible, the cause for the abnormal decrease in the consumption of gas. A similar study has been recently made for the purpose of determining, in respect of the increase in the sales of gas in 1916 as compared with 1915, whether such increase was general or was confined to particular classes of establishments.

The same accounts, about 20,000 in number, which were used in the previous year's comparison, were canvassed again for this purpose with the following results: One hundred and seventy-five laundries showed a decrease in gas consumption of 1.9 per cent. Two hundred and fifty saloons showed a decrease of 2.5 per cent. Four hundred and fifty factories showed an increase of 12.13 per cent. as compared with a decrease of 1.61 per cent. in 1915, and several hundred hotels, restaurants and lofts showed an increase of 9.25 per cent., 12.84 per cent. and 10.03 per cent. respectively, as compared with a loss in 1915 of 2.32 per cent. in the consumption of gas by hotels and an increase of 3.26 per cent. in the quantity used by restaurants, there being no change in that year in the case of lofts.

New Bern, N. C., Gas Company Sold

The New Bern Gas Company, which has for some time been in the hands of a receiver, was to-day sold at public auction and was purchased by W. M. Crane, formerly president of the company.

Mr. Crane was at the head of the company operating the plant before it was disposed of to the company which had it in charge when it was thrown into the hands of a receiver.

He stated that it would be operated without interruption but that there was a possibility that the name of the company would be changed, although there was no intimation as to the new name.

Natural Gas Supply to Industrial Consumers in Northern Ohio Shut Off for Winter Months

The natural gas supply for Northern Ohio, which includes Sandusky, has been shut off from large industrial plants for the Winter months. With one exception, this has been the custom almost from the beginning of the natural gas service in that territory. Last year, however, owing to an exceptional supply and to favorable weather conditions, there was no industrial shut-off.

The percentage of increase in the consumption of gas in dwellings and apartments, as well as in all other classes of business than those above named, varied within a comparatively narrow margin between 1 per cent. and 7.01 per cent. Five thousand prepayment meter accounts (apartment) showed, for example, an average increase of 5.67 per cent. as compared with a decrease of 3.65 per cent. in the previous year, while one thousand miscellaneous stores showed an average increase of 3.10 per cent. as compared with a decrease of 6.49 per cent. in 1915. Five hundred grocery stores showed an average increase in gas consumption of 1.61 per cent. and three hundred and sixty-four delicatessen stores showed an increase of 7.01 per cent. in 1916 as compared with a decrease of 9.63 per cent. and 6.15 per cent. respectively in 1915.

More Than 3,000 Hotel and Restaurant Appliances Installed

The policy of the city, adopted in 1915, of substituting nitrogen-filled electric street lights for incandescent gas lamps, resulted in a reduction in the consumption of gas for street lighting in 1915 of, approximately, 80,000,000 cu. ft. and in 1916 of, approximately, 139,500,000 cu. ft.

The combined station output of the Consolidated Gas Company and its affiliated gas companies in 1916 showed an increase over the output for the preceding year of 4.85 per cent. The increase in the day output was 8.18 per cent. and in the night output 1.52 per cent. From these figures it is apparent that the increase was largely due to an increase in the use of gas for industrial, commercial and domestic purposes rather than for purposes of illumination.

More than 3,000 hotel and restaurant appliances were installed during the past year, including, approximately, a mile of hotel ranges.

During the year the Consolidated Gas Company and its affiliated gas companies installed 193,430 appliances and there were surrendered to the companies 84,578, a net increase of 108,852 in the number of appliances in use, which had been installed by the companies, as against the net increase in the previous year of 90,396 and in the year 1914 of 61,570 appliances.

Difficulty in Securing Coal

It has been very difficult during the year to secure a regular or necessary supply of anthracite or bituminous coal. At times the Consolidated Gas Company and its affiliated gas and electric companies have been obliged to draw heavily on their reserve stock. Many reasons have been given as accounting for the shortage, including wage troubles, strikes at the mines, inability to obtain miners and lack of transportation facilities on the part of the coal railroads. Whatever may have been the real cause, the fact remains that the situation has been at times serious, and, as far as can be ascertained, it is likely to continue to be so for some time.

The construction of the rapid transit subways has greatly interfered with our distributing system and rendered it extremely difficult to comply with the pressure regulations, prescribed by the public service commission. Many miles of gas mains, temporarily placed above ground, are exposed to sudden and extreme variations in temperature, making it at times impossible to retain the normal proportion of illuminating constituents in the gas passing through them, and rendering it very difficult to maintain the candle power required. The loss in calorific value of gas as compared with a loss in candle power is inconsiderable and, as a very large percentage of it is used for industrial, commercial or domestic purposes or for illumination with incandescent mantle burners, the effect of a diminution in candle power, so far as a large majority of consumers are concerned, is negligible.

No change has been made by the Public Service Commission for the First District in the standards of quality of gas, prescribed by the Legislature. In England laws have recently been enacted, making it optional with the companies to elect whether they will work under the candle power standard or the calorific standard. In this country many States are now working under the calorific standard and others are moving in the same direction. In New York the Public Service Commission for the Second District, which includes the entire state with the exception of New York City, has adopted the calorific standard for gas companies within its jurisdiction, including the Westchester Lighting Company.

The development of the incandescent mantle burners, the use of which is now almost universal, the innumerable uses to which gas is put for industrial purposes, have made the candle power standard of gas of secondary importance; the heat in gas being its most important constitutent.

The various departmental schools for the instruction and training of employees in the different branches of the gas business have been actively maintained

A new three-story office building is in process of construction on the south side of Fifty-seventh Street between Broadway and Seventh Avenue, which is to be completed by April 1, 1917, when it will be occupied by the branch office at present located at 112 West Forty-second Street, the lease of which will expire about the time the new building will be ready.

The figures thus far available respecting the Consolidated Gas Company's operations for the calendar year 1916 indicate that its earnings from its gas business, during the year (after deducting the reserve for plant withdrawn from service, contingencies and the appropriation to employees as additional compensation) amounted to $2,086,866.03. For the purpose of determining the earnings, applicable (in accordance with the decision of the United States Supreme Court) to the value of the tangible and intangible property ($80,311,487.27), employed in the company's gas business, there should be added the earnings of The Astoria Light, Heat and Power Company from its gas business, after deducting reserves and appropriations therefrom $1,130,646.21. The total net earnings from the company's gas business for 1916, totaled $3,217,512.24.

This amount is equivalent to 4.06 per cent. on the above stated value of the tangible and intangible property, employed in the manufacture and distribution of the gas sold by the company.

Dividends were paid during the year on the company's capital stock at the rate of 7 per cent. per annum amounting to $6,987,155.00. The dividends and interest, applicable to the year 1916, received on stocks, bonds and other obligations and on advances made to affiliated gas and electric companies, operating in the Boroughs of Manhattan, Queens and The Bronx and the County of Westchester, (excluding interest and dividends, received from The Astoria Light, Heat and Power Company, the earnings of that company from its gas business being included above) amounted to $6,930,107.72.

The interest, which accrued during the year on funded and other debt, chargeable against earnings, amounted to $1,493,155.77. Surplus (including that of The Astoria Light, Heat & Power Company), to be carried to Profit and Loss Account for the year 1916, totaled $1,667,309.19.

Taxes Over $5,000,000

The taxes, charged against the earnings of the Consolidated Company and its affiliated gas and electric companies during the year, amounted to $5,454,125.08 as compared with $4,440,111.13 charged against the earnings of the previous year.

The following is a condensed statement of the company's assets and liabilities, Dec. 31, 1916:

Assets:	
Fixed Assets, including Land, Plant and Equipment	$54,060,833.20
Bonds and Stocks of and advances to Affiliated Companies and other investments	111,109,846.33
Bonds and Mortgages	600,000.00
Cash	2,511,699.96
Accounts Receivable	5,278,599.57
Material and Supplies	985,085.75
	$174,546,064.81
Liabilities:	
Capital Stock	$99,816,500.00
Convertible Debentures	24,846,772.50
Accounts Payable and Accrued Charges	4,116,957.11
Stock Premiums	13,918,878.23
Renewal and Reserve Funds	12,736,260.33
Profit and Loss	19,110,696.64
	$174,546,064.81

There was expended during the year for additions to and extensions of the producing and distributing plants of the various gas and electric companies the sum of $5,032,810.79.

At a cost of $4,381,942.69 for repairs and $2,429,294.58 for renewals or a total cost of $6,811,237.27, all of these properties have been maintained at the highest possible point of operating efficiency, thus insuring the best results as to the quality of the gas and electric service as well as to economy in the cost of the production and distribution of gas and electricity.

University of Michigan Fellowships in Chemical Engineering

The following seven industrial fellowships in Chemical Engineering are to be awarded in the Graduate School of the University of Michigan for the academic year 1917-18.

MICHIGAN GAS ASSOCIATION FELLOWSHIPS IN GAS ENGINEERING. For studies in the manufacture and utilization of gas. Two fellowships of the value of $400 each.

ACME WHITE LEAD AND COLOR WORKS FELLOWSHIP. For the investigation of problems in the manufacture and utilization of paint and varnish. Value $500.

MICHIGAN PULP AND PAPER MANUFACTURERS FELLOWSHIP. For studies in the manufacture of pulp and paper. Value $500.

DETROIT EDISON COMPANY'S FELLOWSHIP. For the investigation of materials used in central station equipment. Value $500.

DETROIT COPPER AND BRASS ROLLING MILLS FELLOWSHIP. For the investigation of methods to produce better copper and brass products. Value $500.

DETROIT STEEL CASTINGS COMPANY'S FELLOWSHIP. For the investigation of methods to produce better steel castings. Value $500.

Application for these fellowships must be made on appropriate blanks and returned to the Dean of the Graduate School by March 1, 1917.

Correspondence may be addressed to Alfred H. White, professor of chemical engineering.

Interesting Gas Heater Lectures

Two very interesting lectures on relief valves and boiler explosions were recently given by Elmer S. Stack, president and engineer of the Stack Heater Company of Boston, Mass. One was a public lecture given in New Bedford at the Master Plumbers' Association, at which the board of health, water board, Journeyman Plumber Trade School and the gas company were invited. He also recently gave a lecture on heating water by gas in Arlington, Mass. On Friday, January 5, he gave a talk on heating water by gas to the Mechanics Trade School in Mechanics Building, Boston. Several lectures on the same subject were given in Malden, Lawrence and Boston. On Jan. 25 he again spoke to the employees of the Arlington Gas Light Company.

GAS HEATING
They Have Arrived—
Two Car Load Lots Gas Steam Radiators
For months we have been unable to meet the demands for Gas Steam Radiators. We can now take care of all orders and assure prompt deliveries.
Our coldest days are not far off. If you have a room, hallway, sun parlor, or, in fact, a whole apartment that you have trouble in heating in extreme weather, we can solve your difficulty.
Gas Steam Radiators
Require no expensive piping, no coal to carry, no ashes, no odor, no smoke, no dust, just heat, when you want it.
They are made of heavy, substantial castings, ornamental in appearance and indestructible.
In chilly weather you simply light the burner and you have steam heat where you want it, and, when the proper temperature is reached, the expense stops.
They are practical and economical to operate. The water chamber is in the lower part of the radiator; directly beneath is a Brunsen Burner and Combustion Chamber.
An automatic regulator governs the supply of gas, guaranteeing the minimum consumption of gas and the maximum of heat.
We carry them in an assortment of sizes to meet the varied requirements.
AIR VALVE
REGULATOR
WATER GAUGE
At Your Service
Lynn Gas & Electric Company
ADVERTISEMENTS LIKE THIS HELPED SELL THREE CARLOADS.

Lynn Company Makes Great Run on Gas Steam Radiators

One of the most remarkable sales campaigns on gas steam radiators is being conducted by the Lynn (Mass.) Gas & Electric Company the present winter. Thus far nearly three whole carloads of gas steam units have been disposed of, and the prospect is for still more to follow. All sorts of buildings are being heated by these radiators—houses, garages, stores, offices, etc.

Newspaper advertising is the principal publicity used in connection with the campaign. The Shoe City has three excellent dailies, and these are used each day, large display ads. being inserted with frequent change of copy. The appliance department is about to mail a display circular to each gas customer on its books, but in reality the force has had about all it could handle to keep up with inquiries received from its newspaper advertisements.

The radiators are sold on the instalment plan, one-third down and the balance in two monthly payments. This will make the payments distributed over the cold season, and make the burden lighter on the user.

The Lynn company has recently added a store adjoining its office floor to its large business rooms. The annex is 85 by 35 feet and is fitted up as an appliance department. A large line of ranges, radiators and smaller appliances for the household are on sale. Down-stairs is an-

other large assortment of burners and stoves. The small burners are arranged on zinc covered tables, each unit being connected with the gas supply, with sheet metal canopy above to carry off odors. The department features hotel and restaurant appliances, these being connected with the gas service and in readiness for demonstration. Practical lessons in the use of these devices are given periodically. The practice is to notify all prospective purchasers, interested parties and others engaged in the same kind of business, of a demonstration at a set time. In this way attention is focused on the particular use to which the appliances are devoted and the special class of trade, whether restaurant, hotel or other business, is shown the advantages of gas service.

The Lynn company does not push electric cooking or heating, confining its electrical propaganda to power, lighting and small domestic appliances. It is strong on the cooking and heating features of its gas business. Its motto "At your service" is consistently lived up to, and explains in large measure the company's remarkable success, despite the comparatively low rates it offers its customers.

What Public Utility Securities Offer to Investors

Midway between railroad and industrial securities, in point of credit and in the opportunity which is given to regularly estimate from public records their earning power, are the public utility issues, stated Charles F. Speare in the New York *Mail*, Dec. 12, 1916. It is important at this time, when careful attention is being given to the investment of funds to carry through the readjustment period after the war, that more information should be set up in regard to the issues of traction, light, gas and power and other so-called franchise corporations.

There has been nothing spectacular in the growth of earnings of the public utilities as a whole. Charts show that this growth has been constant. In periods of industrial depression, when the curve of railroad and industrial revenues went sharply downward, that of public utility earnings moved very little away from its maximum. The economic tendencies of the day favor the public utilities. They have become the necessities rather than the luxuries of daily life. Where one new mile of railroad is projected hundreds of new miles of electric line, of telephone line or of power carrying line are constructed. The best evidence of this is in the increase of $300,000,000 in the stock, bond and note issues of public utilities for the eleven months of this year to November 30 compared with a decrease in those of steam transportation roads.

The railroads are compelled to make regular reports to the Interstate Commerce Commission. It is easy to recall the looseness and almost wicked contempt of a great number of industrial corporations for the demand for publicity of their affairs. Public utility corporations, by law, and from their own recognition of the value to them of public favor, give sufficient data as to their regular operating performances to keep the observant investor informed at all times as to the status of his investment. This is one great factor in their favor.

Another is a very large margin of safety which applies to so many of the bonds and preferred stocks that are just now available for investment. It is to these classes of public utility securities that the recommendations in this article are confined. There are plenty of common stocks representing large equities and undoubtedly moving toward higher levels of price and credit, but for the person who is looking to safety of principal the preferred stock of either a holding or an operating company, or the bond of an operating company, should be exclusively his choice.

First, as to public utility bonds. High as is their credit already it should be higher than it is. These bonds ought to be made legal for savings banks in such states as New York, Massachusetts and Connecticut. The day is not far away when they will be legalized as investments for banks and trustees. What could be better than such issues as New York Telephone first mortgage 4½s or Detroit Edison first 5s? They compare at every investment point with the best of the railroad bonds, which institutions may now buy in this and other states.

To go further, one may pair off with every legalized railroad bond a public utility bond which covers its interest as many times as the former and usually more times. As a matter of fact, a parallel list of legalized and of unlegalized bonds would look absurd. The only reason why public utilities have not been made legal is that pressure has come from vendors of railroad bonds, who do not wish to open their market to competition, and so make the argument that if the market is broadened railroad bonds will suffer and the reserves of savings banks shrink. The law of the "survival of the fittest" must be made to apply in investments as well as in the laws of nature.

The one criticism of public utilities that they have a narrow market, only a few of them being listed, is partially true, but will be corrected by degrees. Plans are now being made to place more of them on the board. It is unfortunate that several very poor specimens of this type of securities should have recently been "rigged" so scandalously on the Stock Exchange.

The investor looking forward to the possible changes of the next few years desires as great stability of earnings for his security as can be had. It is obvious that of all securities the industrials must show the widest fluctuations of price because industrial receipts will shrink fastest. As they shrink railroad earnings will decrease, but not in the same proportion as industrial earnings. There will also be a very definite relation between the decrease in the industrial activity and the earnings of public utility companies, for many of the last named are prospering abnormally from the current activity in mines, smelters, munition plants and iron and steel works, where the power supply and the light required for operations of twenty-four hours against ordinary schedules of eight to ten hours, has been much enlarged. The normal growth, however, will take up this slack, we believe, to a larger extent than it can be recovered in either the transportation or manufacturing industries.

The best railroad bonds to-day yield between 4½ and 4¾ per cent. Equivalent public utility bonds yield ½ of 1 per cent. more. Preferred public utility stocks comparable to preferred railroad stocks, yield 6 per cent. against 5 per cent. in the former instance. These are advantages which the investor, whether or not he needs larger income, owes it to himself to investigate.

Wants Permission to Buy Rosslyn Gas Plant

On the ground that it would be to the public interest for it to own and operate the gas plant of the Rosslyn Gas Company, the Washington Gas Light Company, of Washington, D. C., has applied to the Public Utilities Commissions of the District and Virginia for permission to acquire the outstanding stocks and bonds of the Virginia corporation.

Specific information as to the value of the stock and bonds, the price proposed to be paid and other features of the proposed purchase must be furnished the local utilities board, it notified the Washington Gas Light Company before it can pass upon the application.

In the event of the purchase of the stocks and bonds of this company the Washington company is convinced that Rosslyn consumers would not only get a better quality of gas and improved service, but ultimately obtain a cheaper gas.

Industrial Applications of Gas in Massachusetts

At Milford, Mass., a lunch and restaurant proprietor has installed a No. 215 Blodgett cabinet bake oven, doughnut fryer, vegetable and meat boiler and bungalow automatic water heater. All the appliances consume about 600 ft. per hour, eight hours per day.

A baker at Spencer, Mass., recently put in a Vulcan confectioners' stove having a capacity of 135 cu. ft. of gas per hour for frying doughnuts. Former processes were too slow, so the proprietor, after consulting the Spencer Gas Company, decided on the above. With the new equipment the operation was reduced two hours per "batch."

New Haven Company Grants Bonus Checks

The New Haven Gas Light Company has followed the action of other corporations by giving their employees a bonus of 10 per cent. of their wages from July 1 to help meet the high cost of living. This bonus was given by the company in addition to the quarterly dividends which they receive under the profit-sharing system in use by the corporation.

Checks calling for the amount of the bonus were handed to the employees, accompanied by the following letter, signed by J. Arnold Norcross, treasurer of the company:

"For the purpose of aiding certain salaried and clerical employees to meet the abnormally high expenses of living, a plan has been carefully worked out by the directors by which a bonus of 10 per cent. on the six months' salary up to Dec. 31, 1916, is paid to those who are married or have dependents, and one-half that sum to those who are single."

Many Companies Change Officers

The New York & Richmond Gas Company, operating in Stapleton, New York City, has made several changes in their staff, as follows: W. Hammond, secretary, treasurer and business manager, resigned; John Kohout has been appointed secretary and treasurer; F. E. Newberry, sales manager; John C. Smith, assistant to sales manager.

The Middletown Gas Light Company of Middletown, Conn., recently elected new directors for the ensuing year, as follows: William H. Burrows, H. L. Mansfield, Frank C. Smith, E. W. Camp, William S. Pardee and Edward Bradley, of New Haven, and J. Gordon Baldwin. These directors in turn elected the following officers: president, William H. Burrows; secretary and treasurer, H. L. Mansfield; superintendent, E. C. Weston.

The Alum Rock Gas Company of Oil City, Pa., have elected the following officers for the coming year: president, G. S. Hamm of Knox; vice-president, H. R. Merritt of Oil City; secretary and treasurer, Claude Slicker of Oil City; general manager, H. J. Slicker of Knox. The reports showed the company to be in a prosperous condition.

Price of Gas Fixed for Year at Geneseo, N. Y.

At a hearing held by the state public service commission the controversy over the price of gas was adjusted. The present gas figures in Geneseo are $2 per 1,000 ft. for lighting and $1.50 for fuel. Commissioner Hodson announced at the close of the hearing that he would recommend to the public service commission a rate schedule doing away with the present double-meter system and charging one price for light and fuel alike, that price to be $1.60 per 1,000 ft. if less than 10,000 feet were used by the consumer in a month; $1.50 per 1,000 ft. if over 10,000 ft. were used by the customer in a month, and $1.35 if one uses over 20,000 ft. in a month. Prompt-pay customers will get a figure 10 cents per thousand under these amounts, as the schedule will call for that reduction wherever the bill is paid within ten days after presentation.

Under the old arrangement, on the other hand, no service charge was made, though the company, under the new schedule, will receive a service charge for each consumer of 50 cents per month. All that now is left to do to inaugurate the change is the signing of a formal order by the commission. The matter is left open, however, to the extent that after the new rates have been in operation one year, any unsatisfied party may petition the commission for a change to a higher or lower rate.

Manufacturing Costs in Massachusetts 1915 and 1916

According to advance proof sheets of the forthcoming annual report of the Massachusetts Gas and Electric Light Commission, the following are the unit costs of gas manufactured by several of the largest companies in the state, with figures for the year before compared with those for the most recent year, that ended June 30, 1916. The costs are given in cents per thousand cubic feet made, some items of expense being omitted. Generally, lower total costs are observable for 1916:

Societies and Associations

Society of Gas Engineering of New York City Holds Annual Supper Dance

The Society of Gas Engineering of New York City, exponents of the brighter side of life, again demonstrated at their annual supper dance, at the Hotel Biltmore, Jan. 19, that gaiety and brilliancy are the combined standards by which their festivities are gauged.

Among the 300 members and guests in attendance were the following:

Mr. Gilbert Francklyn.
Mr. and Mrs. G. B. Cortelyou.
Miss Cortelyou
Mr. and Mrs. L. B. Gawtry.
Mr. and Mrs. W. Cullen Morris.
Mr. and Mrs. R. W. Bush.
Mr. and Mrs. Lawrence A. Coleman.
Mr. W. J. Clark.
Mr. and Mrs. J. B. Klumpp.
Mr. and Mrs. G. T. Macbeth.
Mr. and Mrs. C. G. M. Thomas.
Mr. and Mrs. H. M. Brundage.
Mr. and Mrs. C. S. Fox.
Mr. and Mrs. W. G. Morris.
Mr. and Mrs. F. R. Barnitz.
Mr. and Mrs. W. G. Hoyt.
Mr. and Mrs. W. N. McIlravy.
Mr. and Mrs. W. O. Wood.
Mr. and Mrs. G. E. Woods.
Miss Helen Woods.
Mr. R. A. Carter.
Mr. and Mrs. R. A. Carter, Jr.
Mr. and Mrs. C. G. Francklyn.
Mr. and Mrs. G. W. Parkhurst.
Mr. and Mrs. T. I. Jones.
Mr. and Mrs. A. H. Hall.
Mr. Edwin North.
Mr. A. F. Macklin.

The membership of the Society of Gas Engineering of New York City, the headquarters of which are at 130 East Fifteenth Street, New York City, embraces the engineering staffs of the Consolidated and affiliated gas companies. A. F. Macklin, 130 E. Fifteenth Street, New York City, is secretary.

	Wages		Coal		Enrichers		Purifiers		Water		Total Cost		Net Cost Less Residuals Sold	
Company	1915	1916	1915	1916	1915	1916	1915	1916	1915	1916	1915	1916	1915	1916
Boston	3.75	3.36	8.16	8.51	13.25	12.94	.342	.213	.203	.190	28.97	27.22	28.34	25.84
Cambridge	4.87	4.94	25.87	24.57	5.13	4.19	.324	.313	.389	.393	43.97	41.61	31.21	26.49
Fall River	7.04	6.90	18.00	18.17	7.50	7.19	.429	.172	.069	.075	35.93	36.26	24.15	21.26
Holyoke (Munic.)	17.42	17.53	23.42	24.44	9.24	5.69	.415	.420	.222	.261	56.55	56.28	52.43	47.67
Lawrence	10.30	10.06	30.68	29.85	5.78	5.32	.259	.038	.165	.191	50.96	49.39	37.97	34.73
Lowell	10.11	9.46	33.17	29.28	3.50	4.41	.365	.428	.295	.266	53.04	49.69	34.69	34.03
Lynn	4.72	5.06	16.55	17.64	6.37	6.02	.445	.097	.264	.249	33.57	34.44	26.10	25.90
Malden	6.37	5.61	16.19	16.25	7.94	7.33	.165	.133	.416	.521	35.45	32.33	29.50	28.24
New Bedford	5.36	5.27	15.96	17.68	8.05	8.45	.100	.168	.192	.265	33.01	34.96	28.28	29.99
Springfield	6.30	7.30	15.17	16.49	8.02	5.86	.141	.057	.086	.155	34.46	34.70	28.66	28.00
Worcester	4.11	4.20	24.94	22.74	6.51	5.13	.303	.201	.399	.459	48.74	43.68	37.37	34.65

THE WELFARE CLUB, an active organization of the employees of the Meriden Gas Light Company and the Meriden Electric Light Company of Connecticut, held a ladies' night at the regular monthly meeting in January. A bountiful supper was served, with about 80 people present. The special feature of the entertainment held after the supper was an address by Harry Crafts, general manager of the Pittsfield Coal Gas Company, Pittsfield, Mass., and president of the New England Association of Gas Engineers.

THE SUBURBAN GAS & ELECTRIC CLUB, an organization of the employees of the Suburban Gas & Electric Company, operating in Winthrop and Revere, Mass., recently held the annual New Year's party of the club. Turkey supper was served to about 90 members and guests.

THE EMPLOYEES' ASSOCIATION of the Malden & Melrose Gas Light Company recently held their January meeting at the Main Street office building, Fall River, Mass. "Safety first" was the topic for the evening's consideration, and C. E. Paige of the above company conducted a stereopticon lecture, which was backed up with figures of the enormous annual waste occurring from accidents annually, which certainly instilled in every one's mind who was present the value of "safety first" ideas.

Personal Notes

PHILIP ROBERTS of Hartford, Conn., was recently elected a director of the Hartford City Gas Light Company, to take the place of his father, George Roberts, who has retired.

CLARENCE M. HINMAN, secretary and manager of the Columbus Clearing Association for five years, will become assistant to President B. G. Dawes of the Ohio Cities Gas Company of Columbus, Ohio.

CHESTER A. BIRNIE, cashier of the Old Colony Gas Company of East Braintree, Mass., has severed his connection with the firm to take an opportunity which has been offered him in a large manufacturing concern in Boston.

RICHARD HAIG has resigned his position as assistant manager of the gas plant at Freeport, Ill., and will hereafter be associated with the Sun Shipbuilding Company in New Jersey.

H. E. FRASER, acting works foreman in the gas plant of the Wisconsin Public Service Company, Green Bay, Wis., has been transferred to the position of superintendent of distribution in the gas department.

ELMER S. STACK of the Stack Heater Company, Boston, Mass., has recently delivered several lectures in a number of New England cities on heating water by gas.

Construction Notes

New Gas Company Home to Be Built at Tulsa, Okla.

A new two or three-story building to be occupied exclusively by the Osage & Oklahoma Gas Company offices will be erected in Tulsa, Okla., just as soon as a suitable location can be secured, it was announced recently by President G. T. Braden of the O. & O. Corporation.

The gas company has received notice from the Pioneer Telephone Company that it must vacate the offices now used in that firm's building some time this summer. The reason is that the quarters now occupied by the Pioneer are cramped and the extra space in the building will be used by the telephone company. Moreover, the quarters now occupied by the gas company are inadequate and President Braden already had anticipated moving.

The gas company officials hope to secure a site convenient to the business district.

Vast Sum to Be Spent This Year by Pacific Company

The Pacific Gas & Electric Company was authorized to issue $2,500,000 face value of its general refunding 5 per cent. bonds due Jan. 1, 1942, at not less than 90 by the railroad commission recently. The proceeds are to be used for the construction, completion, extension and improvement of the company's system. The Pacific Company's program on Aug. 31, 1916, called for an expenditure upon its system of $6,431,488.18. The company's fixed capital is $127,762,415.

The commission also issued an order permitting the company to reimburse its treasury to the amount of $1,068,803.86 for expenditures to Aug. 31, 1916, and to apply the balance from the sale of its stocks and bonds to construction expenses after that date.

Three New Wells May Mean Dallas Pipe Line

The supply from recently developed wells has added fully 16,000,000 cubic feet of gas to the daily supply already available in the Thurber, Tex., gas and coal fields, W. K. Gordon, vice-president of the Texas & Pacific Coal Company, notified Mayor Lindsley, of Dallas, recently. This additional supply is obtained from three new wells, one of which was brought in Sunday.

It has been proposed that a pipe line be constructed from Dallas and Fort Worth to the Thurber fields. Mr. Gordon assured the mayor that they already have a supply sufficient to furnish the two cities without further drilling.

However, Mr. Gordon advised, the company will continue with its development work so that whenever a pipe line is constructed between those fields and Dallas and Fort Worth there will be no danger of a shortage of gas.

Fairfield, Ia., Plant May Be Improved

Thomas D. Miller, of Chicago, gas engineer for the Iowa Electric Company, recently spent the day in Fairfield, Ia. While there he visited the gas plant, made notes of alterations and improvements which he will recommend for the betterment of the manufacturing equipment and distribution system. He thought that the work he will recommend can be done and the place put in first-class condition in a few months, with the expenditure of several thousand dollars which, he says, his company is ready to do, for with the conditions now existing at the plant it would be impossible to give a first-class service or make any money for the stockholders.

New Bedford, Mass., Company Secures Options on Property

The New Bedford Gas & Edison Light Company, acting through Charles M. Carroll, has recently acquired an option on property bounded by Walnut, Coffin, First and Second Streets.

This land, according to Charles R. Price of the gas company, does not mean a new building. The company is desirous of using it as a place for storing poles and, at the same time, through owning the property, driveways leading to the streets surrounding it can be laid out to facilitate transportation.

Residential Baltimore Has New Lights

Lighting Superintendent Mohr is removing arc electric lights from residential sections of Baltimore, Md., and substituting ornamental gas lamps. He said last night that this was being done in accordance with the department's plan to equip streets outside the business district with a standard lamp and remove the glare from residences.

The new order, made public recently, affects a dozen or more locations which do not need so much light, it was said. They include Gilmor and Baker Streets, Orchard and Tessier Streets, Biddle and Washington Streets, President and Wolfe Streets, Fulton Avenue, Cole and Eagle Streets, and the tracks of the Baltimore and Ohio Railroad, Pulaski and Pratt Streets, Payson Street, at its intersection with Pratt and Ashton Streets, Saratoga and Pine Streets and Myrtle Avenue, and Pulaski Street, north of Edmondson Avenue.

More light is to be placed in alleys and small streets in the sections affected by the "crime wave." In fact, all "dark spots" will be lighted.